SECTION 1.0

EASTERN RANGE

GENERAL RANGE CAPABILITIES

1.1 GENERAL INFORMATION

1.1.1 Local Area and Local Population Information

Headquarters for the Eastern Range (ER) is located at Patrick Air Force Base (PAFB), Florida. PAFB is located on the East Coast of Florida on a barrier island that is separated from the mainland by estuaries and an intervening land mass, Merritt Island. See Figure 1-1. The ER supports two major launch heads located adjacent to each other approximately 21 miles north of the main base. The first of these is Cape Canaveral Air Station (CCAS) located on the northern end of the barrier island. The second, John F. Kennedy Space Center (KSC), is on the northern end of Merritt Island and immediately west of CCAS. The primary launch head, CCAS, covers 25 mi^2 and has a normal daytime population of approximately 7,049 persons distributed primarily in its industrial area, the Integrate-Transfer-Launch (ITL) area, and at the Range Operations Control Center (ROCC), see Figure 1-2. CCAS is bordered on it's East side by the Atlantic Ocean and on the north and west by KSC.

Immediately to the south of CCAS is Port Canaveral (see Figure 1-3) which is the center for several major cruise lines, sport and commercial fishing, restaurants, marinas, shipping, docking, warehousing, the Coast Guard Station, the Army Out-port, the Navy Wharf, and the Navy Trident (submarine) Turning Basin. The port has a working population of approximately 6000 personnel. Cruise Liners depart or arrive daily, each with 1800-2600 passengers. With other visitors to the local businesses and Jetty Park on the southeast corner of the Port, the daily transient population could easily exceed 3,000-4,000 persons.

Other major population Centers in the local area include KSC, the unincorporated area of Merritt Island, and the cities of Cape Canaveral, Titusville, Cocoa, Cocoa Beach, and Melbourne. These areas, their approximate weekday daytime population, and their size are shown in Table 1-1.

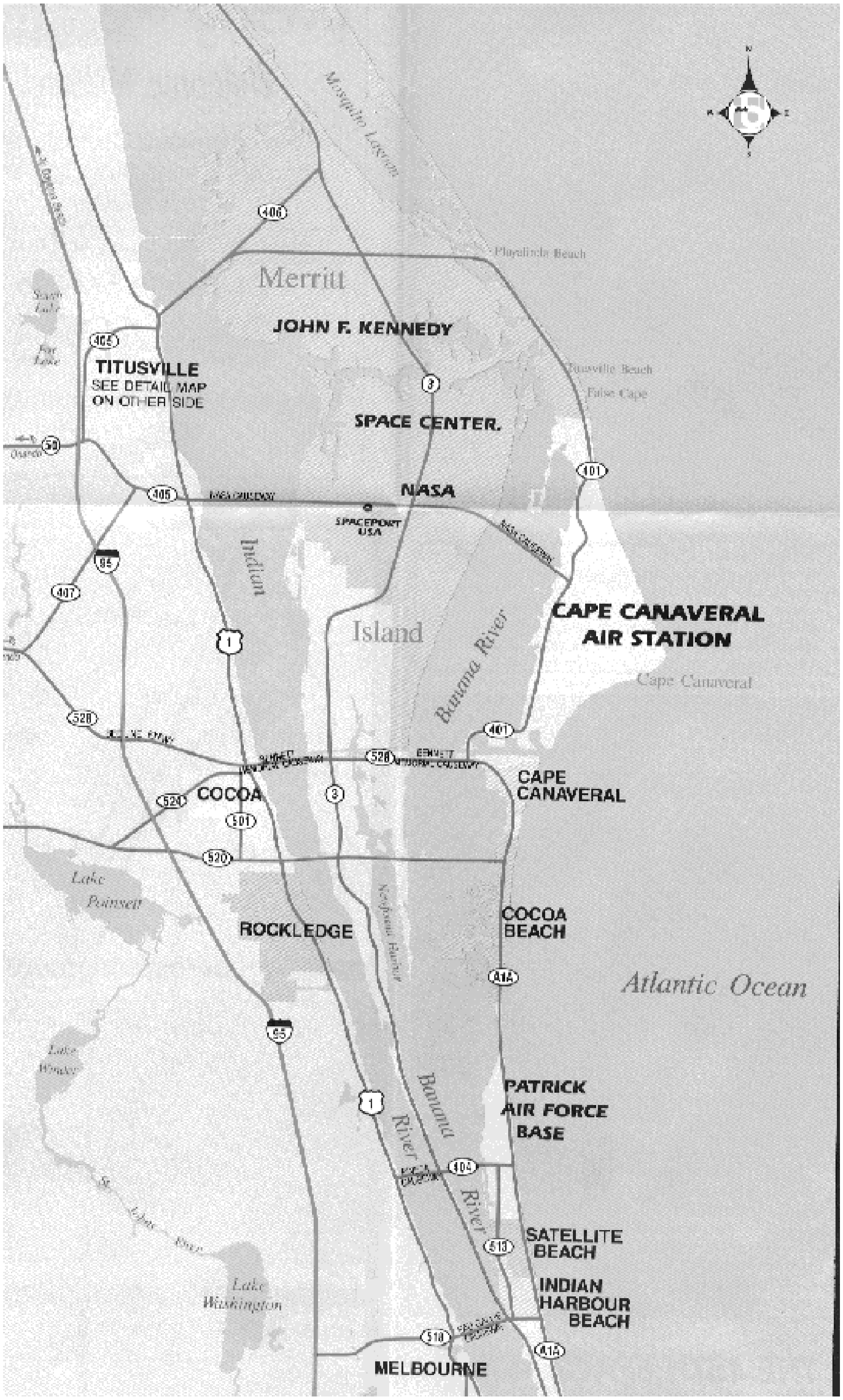


Figure 1 - 1: CCAS and Local Area

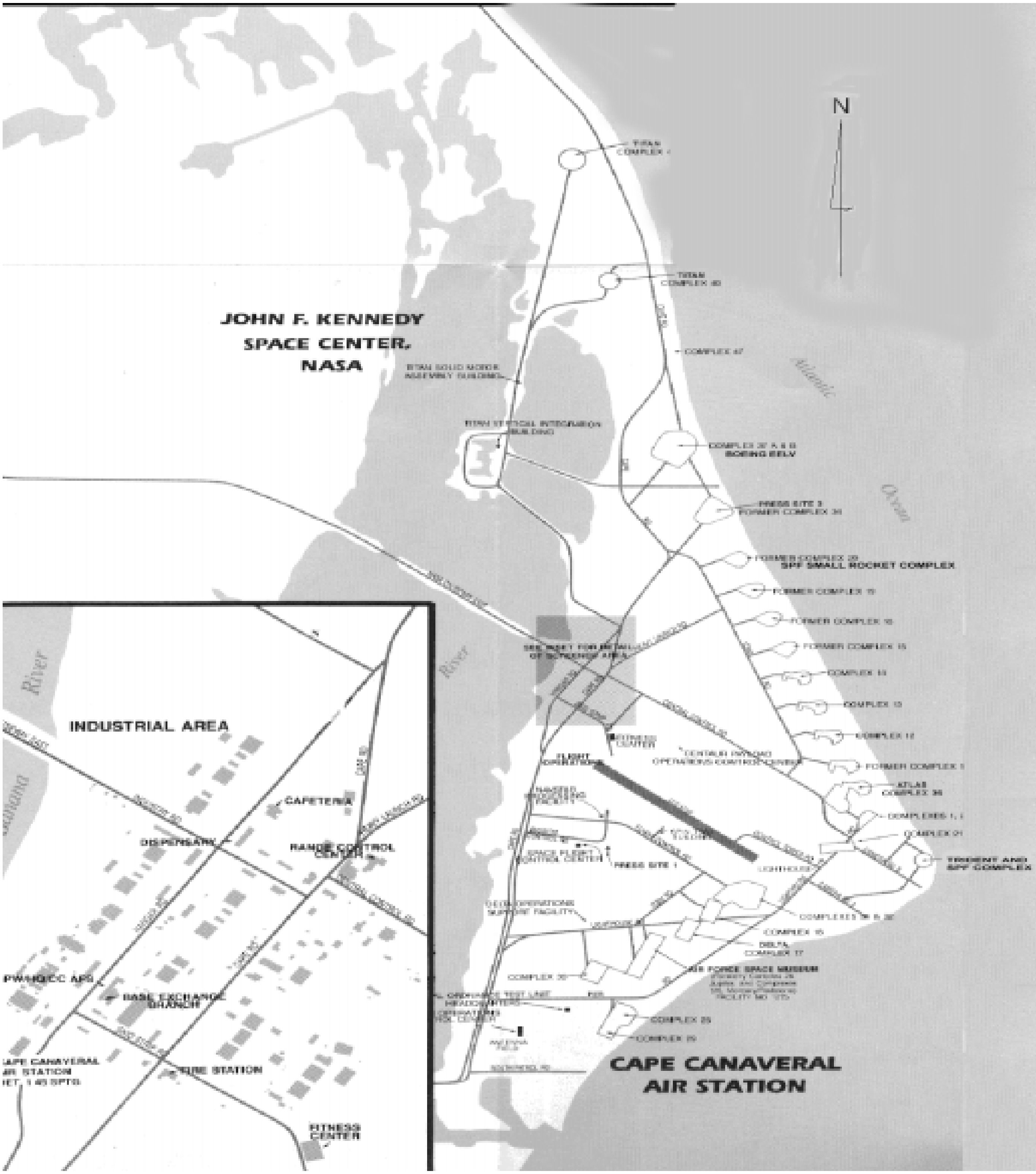


Figure 1 - 2: Cape Canaveral Air Station

Figure 1 - 3: Port Canaveral

Table 1 - 1: ER Local Population Data

Area	Distance from CCAS	Weekday Daytime Population	Area in mi^2
KSC	1 mi West	14,696	218.75
Port Canaveral	Adjacent to the South	>6,000	5.2
Cocoa Beach	6 mi South	13,571	18.0
Cocoa	8 mi WSW	17,982	7.5
Cape Canaveral	1 mi South	8822	1.9
Merritt Island	2 mi WSW	41,864	35.6
Rockledge	8.7 mi SSW	20,458	8.0
Titusville	13 mi WNW	42,000	18
Melbourne	24 mi South	74,489	36.0

1.1.2 Eastern Range History/General Capabilities

The Eastern Range extends from the East coast of Florida to the middle of the Indian Ocean (reference Department of Defense Directive (DODD) 3200.11). In addition to the local instrumentation and support at CCAS, KSC, and PAFB, it has resources at Argentia, Newfoundland, Johnathon Dickinson Park, Florida, Antigua Air Station, and Ascension Auxiliary Air Field (see Figure 1-4).

The Eastern Range started operations October 1, 1940, as the Banana River Naval Air Station. The Range's mission was the support of antisubmarine sea-patrol planes during the WWII. The air station was deactivated in 1947, with the rest of the government land on the barrier island, and maintained in standby status as the Joint Long Range Proving Ground (JLRPG). Control was transferred to the Air Force (AF) and the base was reactivated in May 1950. In August of 1950, the base was renamed Patrick Air Force Base in honor of Major General Mason M. Patrick. The JLRPG became the Air Force Eastern Test Range (AFETR) and then the Eastern Test Range. Upon its transition to Space Command in November 1991, the range became the Eastern Range operated by the 45th Space Wing headquartered at Patrick Air Force Base.

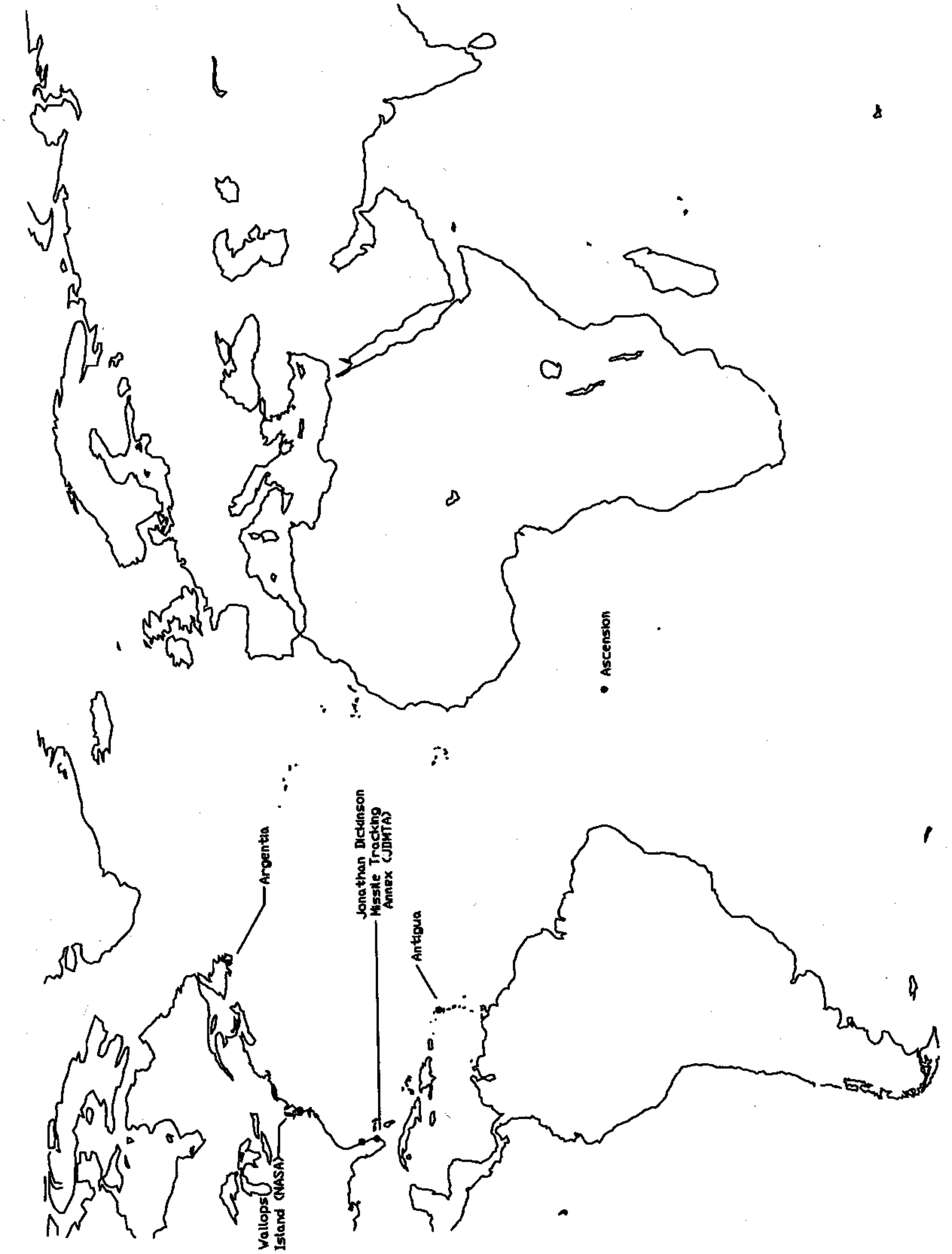


Figure 1 - 4: Eastern Range

Responsibility for developing and operating the Range was given to the Air Force in May, 1950. In the same year, launch pad construction began on Cape Canaveral Air Force Station. The first missile launch, a German V-2 rocket with an Army WAC-Corporal second stage, occurred July 24, 1950. The missile configuration known as “Bumper” signaled the beginning of the Space Age.

To date over 3150 launches have been conducted from the CCAS/KSC launch complexes and off-shore areas. These launches were sponsored by the Department of Defense (DoD) (Army, Navy, Air Force), National Aeronautics and Space Administration, and commercial launch companies.

The over 3150 launches from the ER have included sub-orbital (ballistic) and orbital launches. In the 50’s and 60’s, many of these were land and sea launched ballistic missiles and anti-aircraft missile systems. Since 1989, over 70 of these have been commercial launches. Licensed Commercial launches from the ER have included the Prospector, Delta, Delta II, Titan III, Atlas I, Atlas II, Atlas IIA, Atlas IIAS and Athena II vehicles. These vehicles and a variety of payloads have been flown for the US and foreign agencies and include Great Britain, Japan, Germany, Indonesia, Korea and International Consortiums. All but one of the payloads were orbital missions (communications satellites). Prospector, a Castor IV vehicle, launched in 1991 was a sub-orbital micro-gravity experiment (Joust). The ER has also provided support for Commercial launches sponsored by other lead Ranges such as the Pegasus launch from the Wallops Flight Facility, Wallops Island, Virginia and the French Guiana Ariane Vehicles. Launch projections for commercial missions continue to grow and are rapidly approaching 50-60% of the ER launch schedule.

Eastern Range launch limits, or restraints, are based on the CCAS launch pad locations with respect to population centers both on and off the facility, as well as the U.S. coastal land masses to the north and south, the Caribbean Islands, Bermuda, the northeast coasts of South America, and Africa. In general, vehicles must be launched in an easterly direction and on an azimuth that provides protection for land masses and populated areas from nominal spent stage impacts, vehicle over-flight and other debris generated as a result of destruct actions taken. Approved launch azimuths depend on acceptable impact areas which are driven by the above land masses and associated populated areas. Normally, ER impact areas lie in the Atlantic Ocean between the azimuths of 44 degrees and 110 degrees however, with an acceptable risk analysis, launch azimuths between 37 and 114 degrees can be achieved. (see Figure 1-5). These normal launch azimuths permit orbital inclinations of approximately 28.5 degrees to 52.5 degrees. Impacts are not permitted within 200 miles of a foreign land mass by international agreement. Planned impacts off the coast of the US are approved for each mission. An analysis of the vehicle and mission by range safety personnel is required to determine specific vehicle/mission restrictions. Other limitations are mainly due to site plan

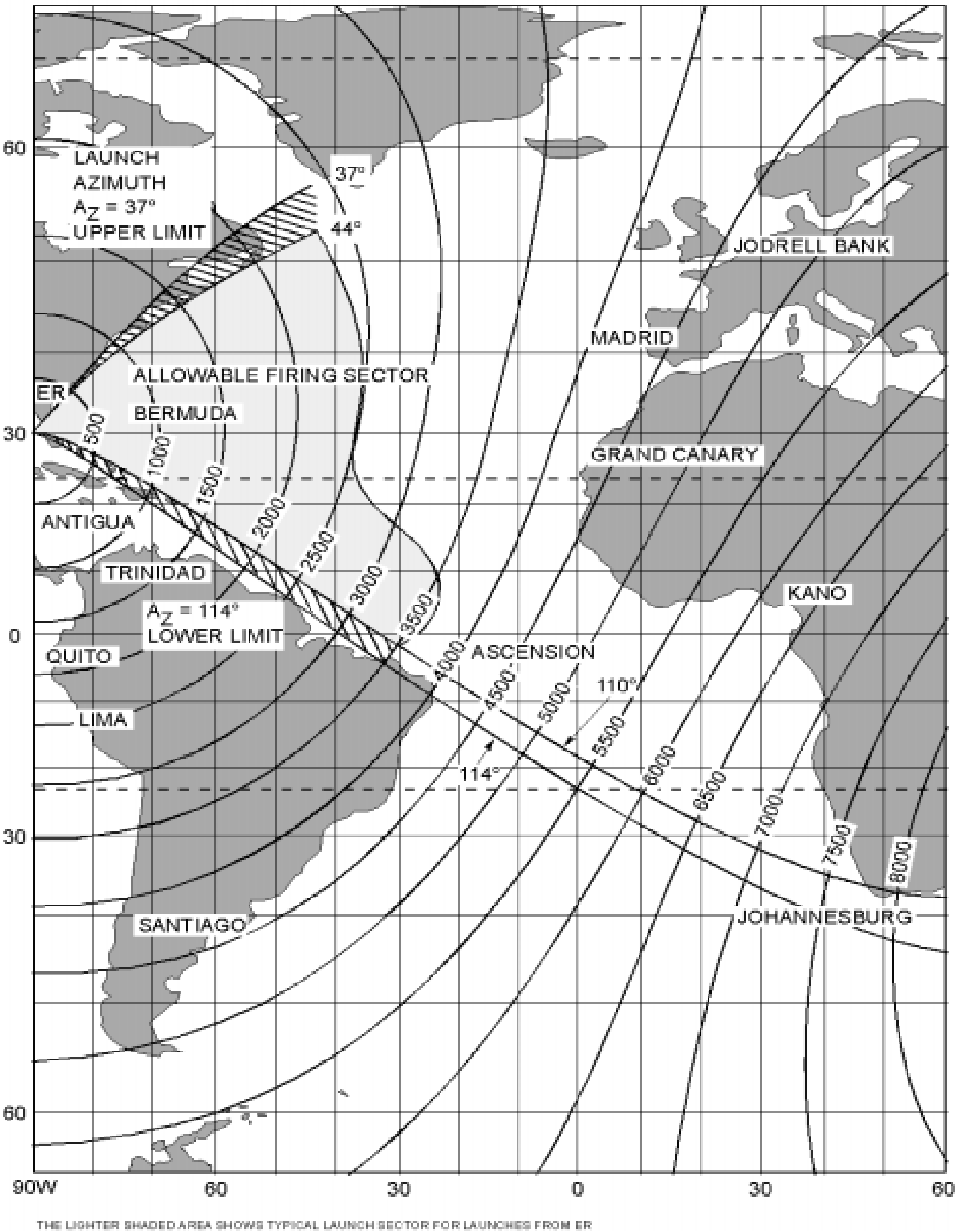


Figure 1 - 5: Azimuth Limits

quantity-distance requirements based on vehicle propellant TNT equivalencies, Flight hazard and blast danger areas that reflect vehicle performance, and consideration of impact areas of spent, separated stages. Both liquid and solid propellant vehicles are launched from the ER.

Delta II has the capability of placing 4010lbs of payload into a Geo-stationary Transfer Orbit (GTO) while the Atlas IIAS will place ~8150lbs into GTO.

1.1.3 Eastern Range Organization

As shown in Figure 1-6, the 14th Air Force falls directly under the United States Air Force (USAF) Space Command. The Commander of Space Command reports directly to the Secretary of the Air Force. The 14th Air Force Commander located at Vandenberg AFB, CA is responsible for operations conducted by the; 45th Space Wing (Patrick Air Force Base, Florida), the 30th Space Wing (Vandenberg Air Force Base, California), the 21st Space Wing (Peterson AFB, Colorado), the 50th and 73rd Space Wings (Schriever AFB, Colorado), and the 721st Space Group (Cheyenne Mountain, Colorado). The Commander 45th Space Wing is directly responsible for operations of the Eastern Range.

The 45th Space Wing Safety Office (SE) is on the wing staff (see Figures 1-7 & 1-8). SE's overall responsibility is to:

- Establish, direct, and manage the ER Commander's overall safety program in flying, nuclear, explosive, missile, ground/industrial, and system safety disciplines;
- Establish and direct the missile flight safety program;
- Ensure all agencies comply with the safety programs;
- Provide safety engineering, program management, and technical advice/ assistance to range users and to the Administrative Contracting Officer in evaluating contracting operations;
- Assist the Commander of the Eastern Range in preparation of the Range Safety portion of Program Support Plans, Operations Directives, and Range contracts;
- Provide technical contract management for the safety portion of the Range Technical Services (RTS) contract and the Safety Support Contract and the ordnance portion of the Launch Operations and Support Contract.
- Provide technical contract management for the safety portion of the NASA and Air Force 45th Space Wing Joint Base Operations Support Contract (JBOSC).

These functions are delegated to and accomplished by the 45SW/SE Sections as detailed in Section 2.

The 45th Space Wing Group Organizational structure is as shown in Figure 1-8.

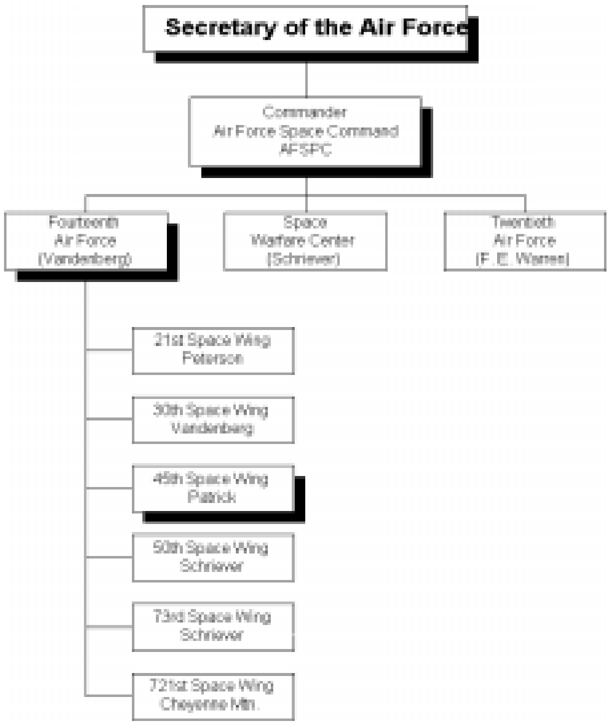


Figure 1 - 6: Chain of Command, SAF to 45th Space Wing

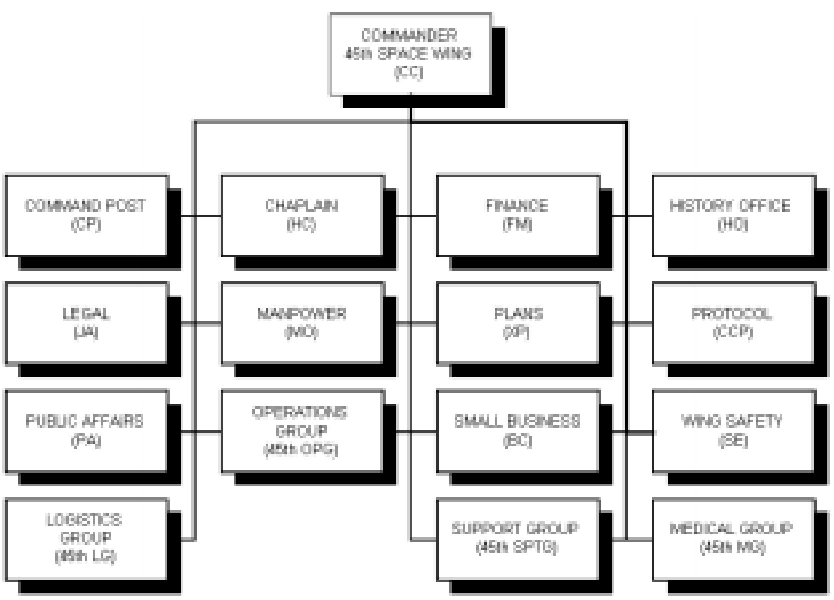


Figure 1 - 7: 45thSpace Wing - Wing Staff

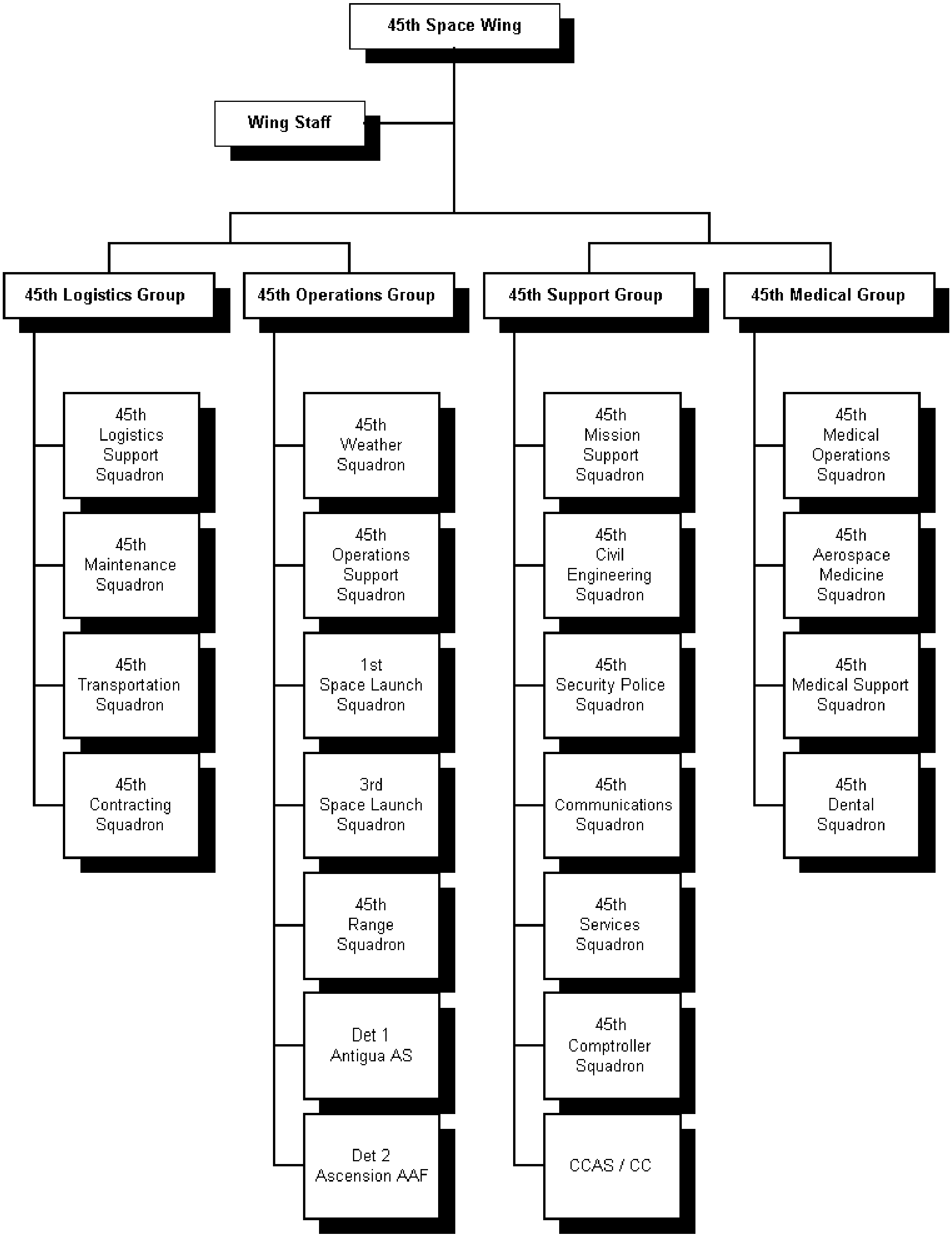


Figure 1 - 8: 45th Space Wing Group Organization

1.1.4 Eastern Range (ER)

Headquarters for the ER is the 45th Space Wing (45SW) located at Patrick Air Force Base (PAFB) Florida on the East central coast of Florida (see Figure 1-1). At CCAS, the 45SW provide spacecraft processing, launch and tracking facilities, safety procedures, and test data to a variety of customers and manages launch operations for Department of Defense (DOD) space programs. Customers include commercial, foreign governments, DOD, and the National Aeronautics and Space Administration (NASA). The ER consists of a series of sites that reach as far north as Argentia Newfoundland and as far south as Ascension Auxiliary Air Field in the South Atlantic Ocean. These sites are augmented by a fleet of Advanced Range Instrumentation Aircraft (ARIA) from the 452nd Test Squadron, Edwards AFB, California. In addition, the range uses instrumentation operated by NASA at Wallops Island, Virginia, and at Kennedy Space Center (KSC) (see Figures 1-1 and 1-4).

CAPE CANAVERAL AIR STATION - The launch head for the ER has active launch complexes for Titan, Delta, Atlas, and small expendable launch vehicles (SELV's). In addition, the ER supports Submarine Launched Ballistic Missiles (SLBM) from designated locations in the North Atlantic. There are more than 20 active and abandoned launch complexes spread along the CCAS Atlantic coastline (see Figure 1-2). The Cape also has facilities for storing rocket motors, hazardous propellants, and liquid hydrogen, oxygen, and nitrogen, and facilities for assembling and testing most missile and payload components. The Industrial Area, a large service complex located on the center west side of CCAS adjacent to the Indian River, includes a dispensary, cafeteria, fire station, fitness center, and offices for military and contractor personnel supporting the various launch efforts at the Cape. Additional mission support comes from Range Weather Operations. This unit launches balloons and weather rockets to gather atmospheric data critical to launch events. Weather Operation's personnel also provide standard meteorological support for all units requiring their assistance. CCAS instrumentation includes radar, command sites, camera and optical sites, and an antenna farm for UHF, VHF, and HF radio communications. Range communications transmitters are located at the Malabar Transmitter Annex in Palm Bay, Florida. The radar site at Patrick Air Force Base and the Recording Optical Tracking Instrument (ROTI) at Melbourne Beach (30 miles south of the Cape) are part of the instrumentation support provided by the Cape.

JOHN F. KENNEDY SPACE CENTER, NASA - The John F. Kennedy Space Center (KSC) is located on Merritt Island immediately to the west and across the Banana River from CCAS (see Figure 1-1). KSC provides direct telemetry and communications support for the ER. It is home to both the ER Telemetry Receiving Site and NASA's telemetry receiving station, Merritt Island Launch Area (MILA). In addition, KSC is the relay point for command, radar, and telemetry support from

Wallops Island, and satellite and other communications routed through NASA's Goddard Space Flight Center (GSFC) for support of ER operations. KSC's large service infrastructure supports the Air Force and its own vehicle assembly, testing, and launch activities and all of its contractor and civilian support personnel. The Space Transportation System (STS) is launched from KSC launch complexes 39A and 39B.

ARGENTIA NEWFOUNDLAND - Argentia is located on the south-central portion of the 43,359 square mile island of Newfoundland that is the eastern portion of the Canadian province of Newfoundland (see Figure 1-4). The ER has mobile C-band radar and command systems located on the grounds of the decommissioned Argentia US Navy Facility (NAVFAC) to support high inclination launches. These systems are manned on an as needed basis (see Figure 1-9). Communications is via leased land-line circuits on an operation by operation basis.

JONATHAN DICKINSON MISSILE TRACKING ANNEX - Jonathan Dickinson Missile Tracking Annex (JDMTA) is located 100 miles south of Cape Canaveral at Tequesta, Florida (see Figure 1-4). It is in an isolated corner of the 10,284 acre Jonathan Dickinson State Park. The site was established to replace the upper mid-range resources that were lost when the Grand Turk and Grand Bahama Island facilities were decommissioned. The site provides radar, telemetry, command, and communications from a unique integrated control facility. It has the capability to simultaneously track 2 separate vehicles. Communications with the Cape are via wide band microwave and landlines.

ANTIGUA AIR STATION - Antigua Air Station is located approximately 1250 miles downrange (250 miles southeast of Puerto Rico) in the northern Leeward Islands of the Caribbean Sea (see Figure 1-4). The tiny 108 square mile island is home of both the Air Station and a US NAVFAC. The Air Station provides radar, telemetry, command, and communications in the mid range for both ballistic and space launch operations. Communications are via a cable system that extends from Antigua to Puerto Rico, the Virgin Islands, and the mainland via and satellite links.

ASCENSION Auxiliary AIR Field - Ascension Auxiliary Air Field is the farthest south of any of the range facilities. It is approximately 5000 miles south east of the Cape in the South Atlantic, 7° 57′ south of the equator (see Figure 1-4). Originally developed to support the 5000 mile range requirements for the SNARK and the NAVAHO weapon systems testing programs, Ascension continues to support Navy Ballistic Missile Testing and the upper stage tracking and burn data requirements for some orbital launches. Data and voice communications are relayed via satellite and HF radio.

Figure 1 - 9: Argentia Newfoundland Instrumentation Site

1.1.5 The Air Force Commercial Program

The Office of the Assistant Secretary of the Air Force (Space) (SAF/SX), leads development of Air Force policy for support of commercial space activities. AFSPC's Commercial Services Branch (within AFSPC/DOPP) has management responsibility for commercial space activities.

AFSPC's Director of Combat Analysis (/DOP) has lead signature authority for the Air Force Commercialization Agreement. While the Space and Missile Systems Center (SMC), at Los Angeles Air Force Base, retains responsibility for booster production matters, they also sign Air Force Commercialization Agreements. The Wing Plans office (45SW/XPR) functions as the single point of contact for commercial space activities and is responsible for coordinating initial support arrangements.

The Air Force uses a variety of processes to arrange support for US commercial space launch operators at Air Force launch bases. Air Force Space Command (AFSPC) has institutionalized processes for the 45SW to use in arranging and providing support for commercial operators. These processes include establishing the new commercial customer, arranging use of excess capacity of Air Force launch property and services, and performing environmental impact analyses. Intermixed with these processes are the standard range documents prepared under the Universal Documentation System (UDS). Discussions of these requirements and the ER processes necessary to support the commercial user are contained within the following paragraphs.

1.1.5.1 Standard Documentation:

45th SW Instruction, 99-101, Mission Program Documents, states the policies, procedures, and instructions for preparing, submitting, and processing mission documents in the Universal Documentation System (UDS), the official documentation system in effect at all national ranges.

The UDS specifies 3 levels of standard documentation. Level 1 includes the Program Introduction and the Statement of Capability. This commercial user/range pair is used to initiate program support planning. Level 2 documents, the Program Requirements Document and the Program Support Plan, may be required to provide additional or more detailed program information, especially for the more complex programs (see para. 1.1.5.1.2). Level 3 documents, the Operations Requirements and the Operations Directive, are used to plan for individual operations within a program. Each document is briefly described below and the flow is outlined in Figure 1-10.

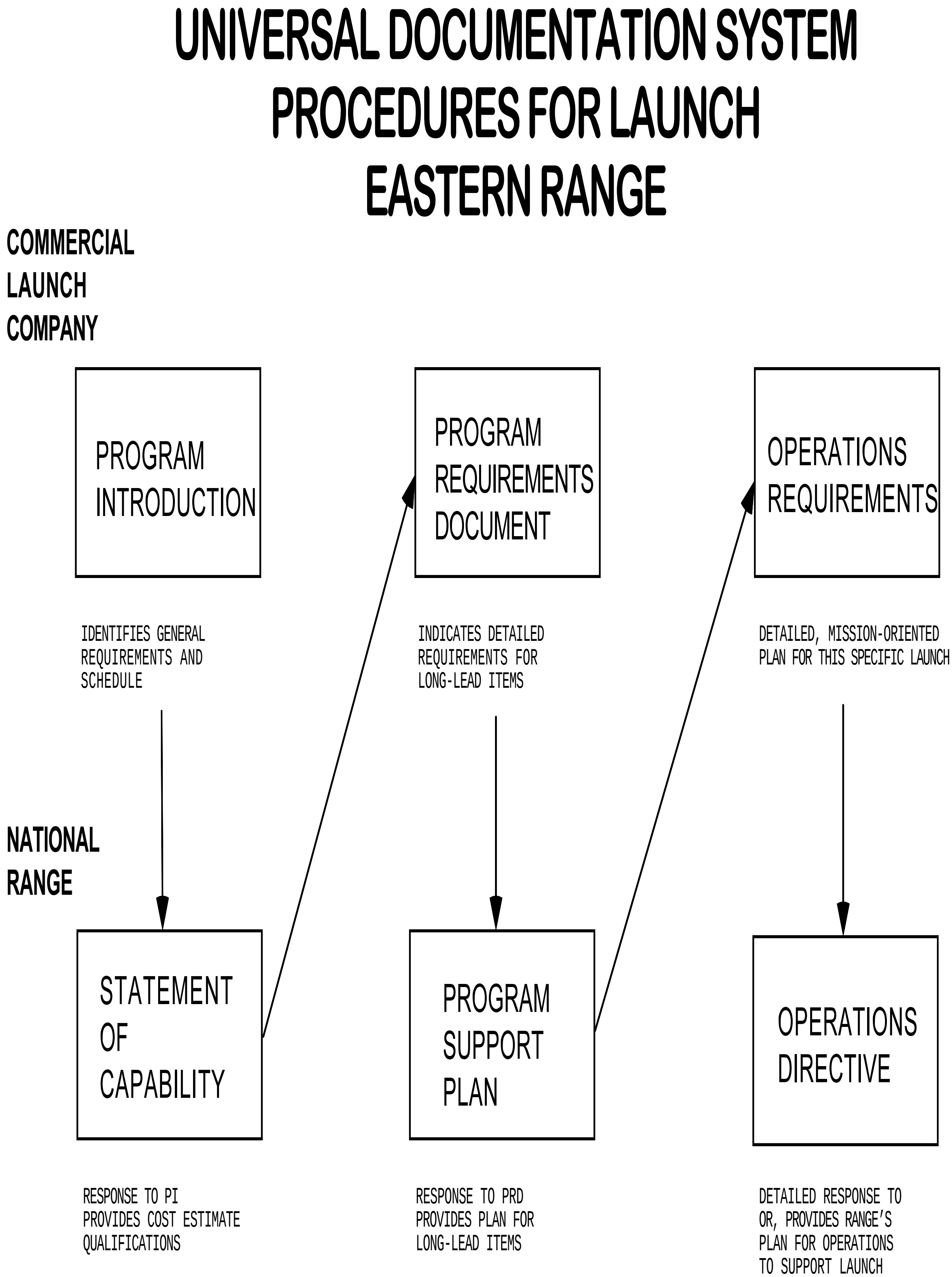


Figure 1 - 10: Standard Document Flow

1.1.5.1.1 Level 1 Documentation:

Program Introduction - The Program Introduction (PI) is the initial planning document submitted by a potential customer to the support agency immediately upon identification of the scope and duration of program activity. It gives a general description of their program, the launch site, trajectory, and mission requirements. The potential customer should submit the PI, using best available information, enabling the support agency to initiate resource and technical planning. This information, while sometimes fragmentary and incomplete, is of substantial value to the support agency in determining the scope of the program. For many programs, the PI is designed to eliminate further documentation except for conduct of specific tests.

Statement of Capability - The Statement of Capability (SC) is the support agency's response to the PI. SEO is normally the Office of Primary Responsibility (OPR) for SE's response and consolidates all of the SE responses for the Chief of Safety's signature. The SEO input, along with the inputs from other ER staff agencies, is included in the SC. When signed, the SC is evidence that a program has been accepted for support by the support agency; subject to approval by higher headquarters, when applicable. Support conditions, qualifications, and resources, or other considerations, are initially identified by this document and serve as a baseline reference to subsequent acceptance and commitment by the support agency. The PI and the SC complement each other in establishing the scope of the program support activity.

NOTE: SEO should make the decision regarding the need for a Flight Termination System (FTS) during the preliminary design review. This may precede the PI document. Coordination between the range user and SEO during this time frame on the need for a FTS may be achieved by other correspondence and/or personal contacts/meetings. The SC must contain the SEO position on the need for a FTS.

1.1.5.1.2 Level 2 Documentation:

Program Requirements Document - The Program Requirements Document (PRD) is a detailed full-program planning document normally required for complex or long lead-time programs. It contains the requirements for support desired from the support agency and may contain supplemental information when needed for clarity of purpose. It should include the specific trajectory of the planned mission. The need for a PRD will be determined during the analysis of the PI or during early planning meetings and will be so stated in the SC. A PRD is submitted to assure that support capability will be available during the time period required by the user organization. Requirements should be submitted immediately upon identification. The user should not delay submittal of the PRD because of incomplete knowledge of support requirements.

Program Support Plan - The Program Support Plan (PSP) is a response to the requirements presented in the PRD and is prepared by the responsible support agency. This response indicates those requirements that can be met from existing resources, those that can only be met through programming new resources or through alternatives, and those which cannot be met by the support agency. The PSP is prepared on a series of forms similar to the PRD and retains the same outline and format. It is maintained current with revised program requirements by corresponding revision for the duration of the program.

1.1.5.1.3 Level 3 Documentation:

Operations Requirements - The Operations Requirements (OR) document is a mission oriented document that describes in detail the requirements for each mission, special test, or series of tests. The OR is prepared by the range user. The PRD and OR must be complete documents capable of standing alone. The OR must not reflect new requirements not previously stated in the PI and/or PRD.

NOTE: 45SW/SE prepares a Range Safety Operations Requirements (RSOR) document to detail mission-specific requirements. RSOR's are prepared for all launch vehicles, including meteorological rockets.

Operations Directive - The Operations Directive (OD) is the support agency's response to the OR and is a detailed plan for implementation of support functions for a specific operation or series of operations. SEO reviews the OR and provides an input to the OD to be included with inputs from SES and all 45SW units. The OD is the official range publication that mobilizes the resources available to the ER. The purpose of the OD is to:

- Form an official reply to the OR,
- Establish a basis for scheduling the mission,
- Commit range support,
- Provide support operating instructions.

1.1.5.2 Establishing the New Commercial Customer

The following paragraphs explain the processes by which the new commercial customer is introduced to the procedures, documentation, and requirements by which the range operates:

1.1.5.2.1 New User Introduction Process:

The process by which these documents and the associated agreements meld to form a cohesive commercial program begins when the potential commercial Eastern

Range user makes initial contact with FAA's Associate Administrator for Commercial Space Transportation (AST) and the ER Wing Plans Office, 45SW/XPR. The Wing Plans office will participate in general discussions with the commercial operator, focusing on the feasibility of supporting the proposed new program, within launch base constraints.

1.1.5.2.2 Mini Agreement:

Once the proposed new program is sufficiently defined, and the amount of government effort required to continue a dialogue with the prospective new user is justified, then the Wing Plans office recommends that the Wing Commander sign the Interim (Mini) Agreement with the commercial operator. The Mini Agreement defines the terms and conditions for initial planning support.

1.1.5.2.3 Initial Support Documentation:

With the Mini Agreement in place, the Wing Plans office will work closely with the commercial operator to produce a Program Introduction, documenting support requirements for the new program. In response, Wing Plans will produce a Statement of Capability (SC) outlining government support. The SC does not represent a government support commitment until it becomes part of the signed Air Force Commercialization Agreement, and the environmental impact analysis process is completed.

1.1.5.2.4 Air Force Commercialization Agreement:

This Agreement represents the government's commitment to provide support for the commercial program, subject to satisfactory completion of the environmental impact analysis process. The commercial operator sends a written request for AFSPC/DOP to execute the Air Force Commercialization Agreement with them. AFSPC/DOPP will obtain a complete Annex from the 45SW (signed by the Wing commander). After coordination through the HQ AFSPC staff, AFSPC/DOPP will return a copy of the Agreement to the commercial operator, signed by AFSPC/DOP and SMC/CL. The Air Force has to issue a lease or license for use of the requested property and also requires an EBS. After the commercial operator signs the Agreement, and obtains a FAA/AST license for launch processing, the launch provider is in the position to begin launch operations and request and obtain government support under the terms and conditions of the Agreement.

The Commercial Space Operations Support Agreement (CSOSA) has been signed by both Air Force and Industry officials and sets the stage for implementation at both the Eastern and Western Ranges. The agreements establish a framework by which the military will furnish government owned space launch facilities and related property to commercial users.

1.1.5.3 Using Excess Capacity of Government Launch Property:

This section contains the process required to initiate facility siting, the requirements for leasing Air Force real estate, and the Environmental Impact procedure that is required.

1.1.5.3.1 Facility Siting Process:

In parallel with the Environmental Impact Analysis Process (1.1.5.3.3), the commercial launch operator should initiate the facility siting process through the Wing Plans office to 45th CES/CE. This process consists of two sub-processes, initiated by a request letter from the commercial operator to the Wing commander. The sub-processes consist of: (1) the explosive safety siting approval process that accounts for quantity-distance standoff requirements for explosive storage and launch facilities, as defined in DoD 6055.9-STD and Air Force Manual 91-201, and (2) the comprehensive planning process, based on land use plans and constraints documented in the CCAS General Plan. The Wing Plans office monitors progress and attends the Wing Facilities Board meetings and acts as the commercial operator's advocate when the Board addresses the commercial operator's site plan request.

1.1.5.3.2 Lease Requirements and Process:

Air Force Instruction 32-9003 "Granting Temporary Use of Real Property" requires non-Air Force users of real estate at Air Force bases, where new facilities are to be constructed, to execute a lease for use of the real estate. Approval authority for leases exceeding five years or $200,000 rent per year rests with the Deputy Assistant Secretary of the Air Force/Installations (SAF/MII). Following SAF/MII approval, authority for negotiating, processing, executing, and administering leases is delegated to AFSPC. Below the $200,000 amount, authority is delegated to the Wing. Leases and Licenses require an Environmental Baseline Survey (EBS) and a Commercial Space Operations Support Agreement (CSOSA), ref. Section 1.1.5.2.4.

1.1.5.3.3 The Environmental Impact Analysis Process:

The President's National Space Policy establishes that commercial space activities at federal launch facilities comply with the National Environmental Policy Act (Public Law 91-190, NEPA). Commercial operators must complete the Environmental Impact Analysis Process (EIAP) before the Air Force can commit support to their programs through the Air Force Commercialization Agreement. The Mini Agreement allows the Air Force to provide planning support until the EIAP is complete. "HQ AFSPC Environmental Protection Committee (EPC) Guidance on Commercial Space Activity EIAP" (October 1991) explains the process for completing the EIAP and is detailed in AF 32-7061.

- **Air Force Form 8133:** Request for Environmental Impact Analysis: This document forms the basis for the decision on what level of environmental documentation will be required for the proposed program (i.e., CATEX, Environmental Assessment, or Environmental Impact Statement).
- **Categorical Exclusion:** According to the President's Council on Environmental Quality regulation 1508.2, "a categorical exclusion (CATEX) means a category of actions which individually or cumulatively do not have a significant effect on the human environment." The Air Force list of excluded categories appears as Attachment 7 Air Force Instruction (AFI) 32-0761 and previously assessed actions qualify for a CATEX. Examples of programs in this category include those covered by the "Programmatic Environmental Assessment of Commercial Expendable Launch Vehicle Programs," published by the Federal Aviation Administration's Associate Administrator for Commercial Space Transportation (FAA/AST) in February 1986. The scope of this document is limited to privatized versions of government boosters using the same facilities and flying the same trajectories as previously-approved government programs.
- **Environmental Assessment:** For new programs, an Environmental Assessment (EA) may be sufficient for environmental approval, if it justifies a Finding of No Significant Impact (FONSI). For commercial programs using Air Force assets, 45th CES/CEV Environmental Planning Flight selects and manages a contractor to prepare the EA and FONSI. The review process includes coordination among the environmental office at the launch base and local, state, and federal regulatory agencies. The FONSI is executed by the AFSPC decision maker. Depending on the scope of the program and the regulatory agencies involved, the EA/FONSI process typically requires six to twelve months.
- **Environmental Impact Statement**: An AF 813 must be submitted and analyzed to determine what level of environmental documentation is required. The review process includes coordination within the Air Force, a series of public scoping meetings and hearings to address any controversial issues, and interface among the environmental offices at the launch base and local, state, and federal regulatory agencies. A Secretary of the Air Force decision maker will execute the Record of Decision. Depending on the scope of the program and the regulatory agencies involved, this process typically requires twelve to thirty- six months.
- **Permits and Additional Studies:** Depending on the scope of the program, in addition to the EA or EIS, reports and permits for issues like emissions, storm waters, waste waters and hazardous waste may be required by regulatory agencies external to the Air Force. The Range Environmental office 45CES/CEV may assist the commercial operator with preparation of these documents. The commercial operator coordinates all permit applications through the Range Environmental office 45CES/CEV. When permits for commercial activities are issued, some may be to the Air Force and some may be to the commercial operator. All permits must be compiled and held by the commercial operator.

1.1.5.4 Summary:

The Air Force's Commercial Program has evolved to provide necessary launch support and services that are not readily available in the commercial realm. Access to these services begins with initial contact by the commercial operator with the FAA/AST and the 45SW Plans office. The process of establishing the new commercial customer is intertwined with the development of standard (UDS) documentation, the commercial license process, and ER/Customer agreements, as well as operations siting, leasing, and environmental impact assessment.

1.2 RANGE DESCRIPTION

As stated previously, the Eastern Range (ER) originates at the Cape Canaveral Air Station (CCAS) on the upper end of the barrier reef making up Florida’s mid-east coast, and extends through the Atlantic Ocean, across Africa, and into the middle of the Indian Ocean. The launch complexes and major support facilities are located on CCAS (see Figure 1-11). The principal Cape facilities and launch sites are used to store, process (assemble), checkout, and launch solid and liquid fueled vehicles that carry payloads into sub-orbital low earth and geo-synchronous/geo-stationary orbital trajectories.

1.2.1 Complexes and Facilities

The Cape’s boundaries encompass complete assembly and launch facilities for ballistic missiles, space-launch vehicles and satellites, and storage and dispensing stations for fuels and oxidizers. Other types of complexes and facilities located at CCAS include blockhouses, booster preparation and payload check-out buildings, dynamic balance equipment, a timing/communications facility, wind measuring devices, communications and control instrumentation, television and optical tracking stations, surveillance and tracking radar units, and other supporting facilities (over 1600 facilities in all). Active launch sites include Space Launch Complexes 40 and 41 and part of the Integrate, Transfer and Launch Facility where all preparations and launch of the Titan IV and commercial Titan are conducted. Complex 41 is currently under modification in support of the proposed Evolved Expendable Launch Vehicle EELV LMA Common Core Booster program. Department of Defense satellites also are processed here in the Satellite Processing and Integration Facility. Global Positioning System satellites and Delta vehicles are processed at the Cape and launched from Space Launch Complexes 17A and 17B. Space Launch Complex 20 is used for sub-orbital launches and is currently under review to conduct space vehicle operations as proposed by the Spaceport Florida Authority The Atlas is launched from Space Launch Complexes 36A and 36B. Space Launch Complex 37 is under going modification to support the proposed Evolved Expendable Launch Vehicle (EELV) Boeing Delta IV program. Launch Complex 46 has been converted to support launches for the Athena class space vehicles in agreements with the Air Force and the Navy. Weather rockets are launched from the Meteorological Rocket Launch Facility at Launch Complex 47. Acreage is available for future construction to support launch of alternate concept vehicles (hybrid propulsion systems). Because of over-flight restrictions and facility siting requirements, new construction could restrict launch azimuth limits.

The CCAS launch complexes and facilities are located adjacent to the beach (see Figures 1-2 and 1-11 for CCAS complex and facility locations). Descriptions of

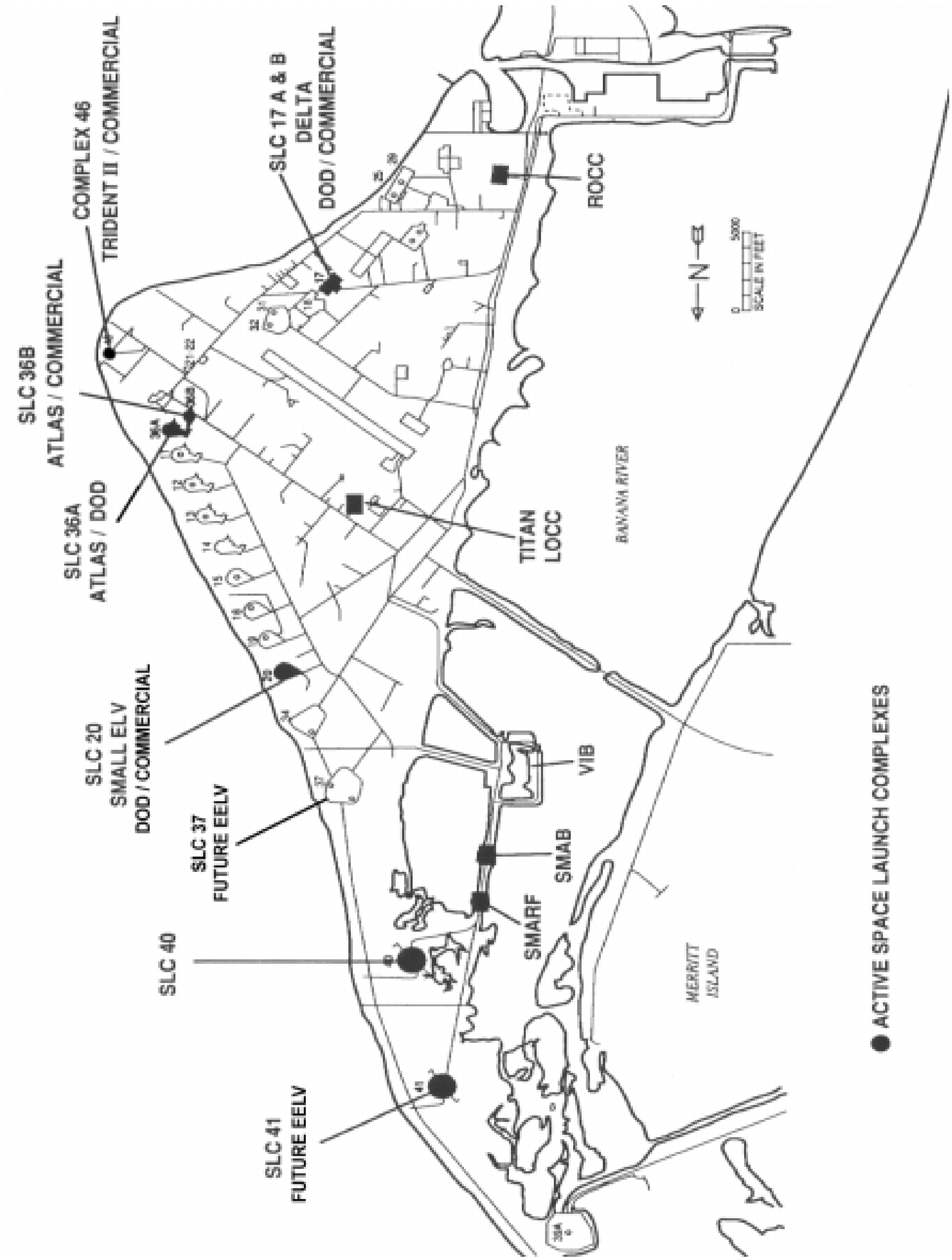


Figure 1 - 11: ER Launch Head. Cape Canaveral Air Station

inactive areas, active commercial pads, and facilities are included in the following paragraphs:

- Complexes 1 & 2 - These complexes (see Figure 1-2) located in the southern area of the CCAS were constructed for the SNARK winged missile program, and supported some MATADOR combat training launches in the 1950s. The Air Force accepted the sites in 1953, and the complexes continued to support SNARK launches through 05 December 1960. Both pads served as helicopter pads for the MERCURY program in the early 1960s, and both complexes supported tethered aerostat (balloon) programs from 1983 through 1989. These sites are currently inactive.

- Complexes 3 & 4 - Also located to the southeast of Space Launch Complex (SLC) 36 (see unmarked sites adjacent to Complexes 1 and 2 in Figure 1-2), these pads were originally constructed to support the BOMARC interceptor program. These pads also supported BUMPER, JASON, REDSTONE, X-17, and POLARIS ballistic missile operations. During the 60's, some of the support facilities were converted into a medical support area for Project MERCURY. Along with Complexes 1 & 2, both sites supported the tethered aerostat programs in the 80's. These sites are currently inactive.

- Complexes 5 & 6 - Originally designed to support JUPITER and REDSTONE, these pads later supported PIONEER and EXPLORER as well. All six of the REDSTONE/MERCURY sub-orbital missions originated from these sites. They are currently assigned as part of the USAF Space Museum (see Figure 1-2). These sites are listed on the national registry as part of the national historical landmark.

- Complexes 9 & 10 - Originally constructed to support the NAVAHO winged intercontinental missile program, these sites supported 11 launches before they were demolished in 1959. Minuteman Complexes 31 and 32 replaced them (see Figures 1-2 and 1-11). These sites are currently inactive.

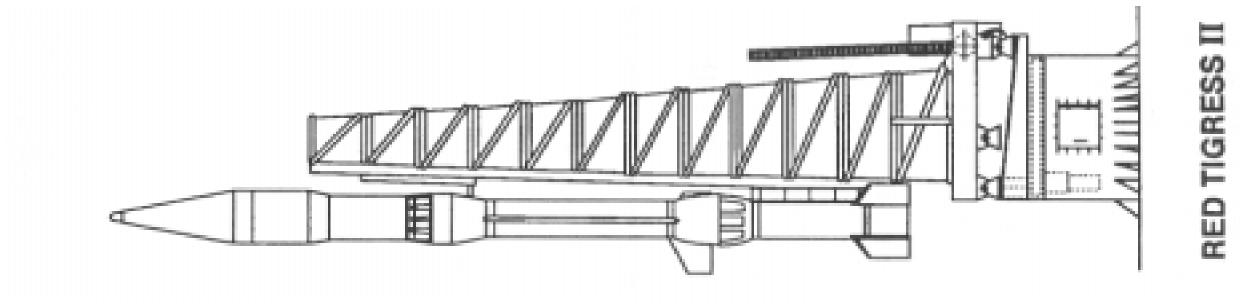
- Complexes 11, 12, 13, & 14 - These complexes were built for the ATLAS ballistic missile program. These complexes, built in the late 50's, are located along CCAS's eastern coastline (see Figure 1-11). These sites were quite active during the late 50's and 60's. Complex 11 supported 28 ATLAS launches and 5 ATLAS Advanced Ballistic Reentry System flights. Complex 12 supported its first ATLAS launch on 10 January 1958, and it 9 RANGER and 4 MARINER missions in the 1960s. Complex 13 supported 51 ATLAS and ATLAS/AGENA flights. Most of the ATLAS/AGENA missions were for NASA; however, the last 11 were for DOD. Complex 14 supported 32 ATLAS and ATLAS/AGENA missions, including four manned MERCURY missions and seven unmanned GEMINI target vehicle launches. All of these complexes are inactive at this time. SLC 13 and 14 are designated as a national/historic landmark.

- Complexes 15, 16, 19, & 20 - These four sites were started in 1959 to support the TITAN I Ballistic Missile Program (see Figure 1-11). In 1962, Complexes 15 and 16 were modified to support the TITAN II Ballistic Missile Program. Complex 15 was then deactivated and dismantled in 1967. The other sites were modified to support other programs. Complex 16 was turned over to NASA to support Apollo Service Module testing. Once the Apollo testing was completed, the site was returned to the Air Force and then reassigned to the US Army in 1974 to support PERSHING testing. 79 PERSHING IA's and 49 PERSHING II's were launched before the site was deactivated in 1988 in accordance with the Intermediate Nuclear Forces Treaty. Upon deactivation, all PERSHING equipment was removed. Complex 19 became the space programs only manned TITAN II/GEMINI launch complex. It was the launch site for 2 unmanned and 10 manned GEMINI missions before its deactivation in 1967. In 1984, the site was declared to be a national historic landmark. Complex 20 (now SLC-20) was modified to support the TITAN IIIA launch program. It supported 4 TITAN IIIA launches before its deactivation in 1967. Reactivated in 1987, it supported the STARBIRD program, followed by the ARIES and RED TIGRESS missions. All were sponsored by the Strategic Defense Initiative Organization. SLC-20 is maintained as a Small Expendable Launch Vehicle (SELV) support site and is being considered for use by the Spaceport Florida Authority for commercial space activities. Figure 1-12 shows the pad and RED TIGRESS with the current blockhouse, camera sites, and Launch Equipment Buildings (LEB) adjacent to each site. In addition, it shows an artist concept of the rail launcher from which RED TIGRESS II was launched.

- Complex 17 - This dual launch pad complex was built for the THOR ballistic missile program in 1956. Pad 17B supported it's first THOR launch on 25 January 1957, and Pad 17A supported it's first THOR launch on 30 August 1957. In addition to THOR missile launches, Complex 17 began supporting space launches in the late 1950s. The site was modified in the early 1960s to support a whole host of launch vehicles derived from the basic THOR booster. Thirty-five DELTA missions were launched form Complex 17 between the beginning of 1960 and the end of 1965. The Air Force transferred Complex 17 to NASA in the spring of 1965, but the site was returned to the Air Force in October 1988 to support the DELTA II program. As DELTA II launches continued over the next decade, Pad 17B was modified in 1997 to support the new more powerful launch vehicle (DELTA III). In all, Complex 17 Supported over 270 major missile and space launches to date (see Figure 1-13).

- Complex 18 - This complex included two launch pads 18A and 18B. Pad 18A was used to launch 14 VANGUARD space vehicles for NASA and the U.S. Navy between 08 December 1956 and 19 September 1959. Pad 18B supported 17 THOR missile launches between 04 June 1958 and 01 March 1960. Following termination of the VANGUARD program, Pad 18A supported 10 BLUESCOUT I, BLUESCOUT II and SCOUT missions between 07 January 1961 and 13 April 1962. Complex 18 was deactivated on 01 February 1967 and remains inactive (see Figures 1-2 and 1-11).

- Complexes 21 & 22 - Located 3/4 mi south of SLC-36 and near the Cape lighthouse (see Figures 1-2 and 1-11), these complexes were built to support the Air Force's winged BULL GOOSE decoy missile project. In all, 5 dummy and 15 live BULL GOOSE and GOOSE vehicles were launched. The sites were later modified for the MACE vehicle and supported 44 MACE and MACE B winged cruise missile launches. These sites were deactivated in the early 70's and remain inactive.



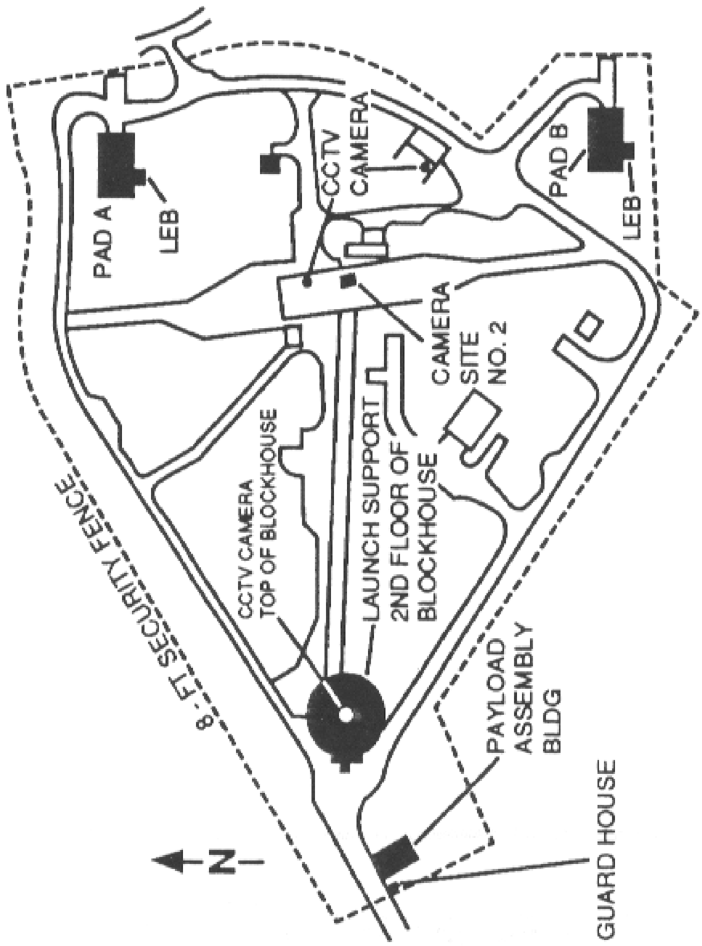


Figure 1 - 12: SLC 20 and Representative Vehicle

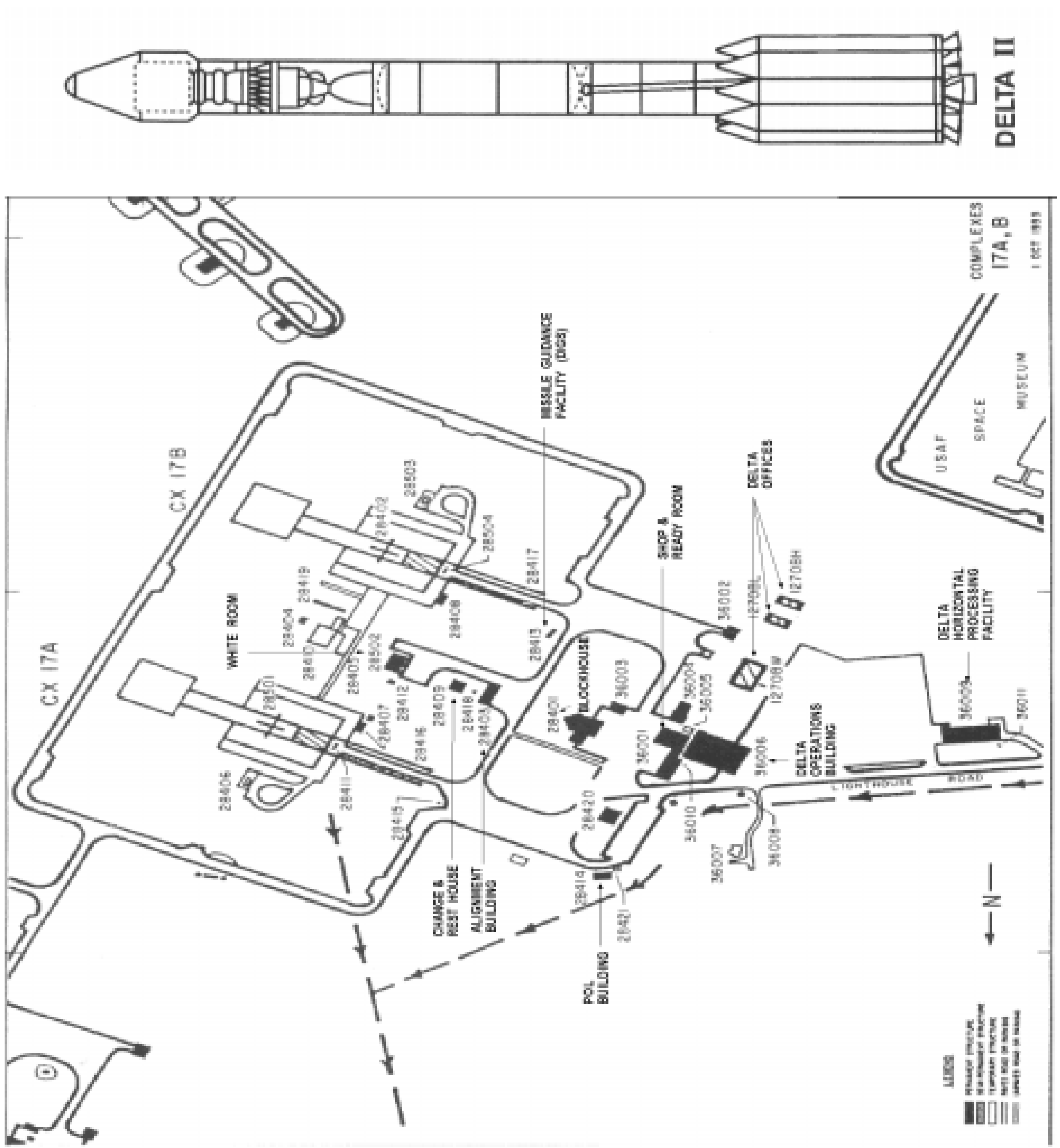


Figure 1 - 13: SLC 17 and Representative Vehicle

- Complex 25 - Located approximately 1.5 mi to the SSW of SLC-17 (see Figures 1-2 and 1-11), complex 25 consisted of 4 pads built to support US Navy programs. 25A and B were started in 1957 and 1958 respectively. From these pads, 68 POLARIS missiles were launched as part of the development testing of these Sea Launched Ballistic Missiles (SLBMs). Pads 25C and 25D were built in 1967 to support the Navy's POSEIDON ballistic missile program. From these pads, 17 POSEIDON launch vehicles were launched in 1969. The two original pads were disabled while pad 25C was modified to support the TRIDENT I program. In 1979, after launching 17 TRIDENT I missiles from pad 25C, the Navy deactivated and dismantled the site. It remains inactive at this time.

- Complex 26 - Pads 26A and 26B were constructed in 1956. They supported the REDSTONE, JUPITER, JUPITER C, and JUNO II programs. At least 36 launches were conducted from these pads before their deactivation in 1964. Late in 1964, this complex was reassigned and developed into the USAF Space Museum (see Figures 1-2, 1-11, and 1-14).

- The museum opened in 1966 with the blockhouse, an exhibit hall, and an outside area featuring 70 missile, space vehicles, and the pad gantries on display. In 1984 the complex was declared part of the national historic landmark for man in space.

- Complex 29 - Located adjacent to Complex 25 (see Figures 1-2 and 1-11), Complex 29 was built in 1958 to also support POLARIS testing for the Navy. Forty-seven POLARIS vehicles were launched before the pad was upgraded to support the British CHEVALINE Ballistic Missile Testing Program. The site was deactivated in 1980 after supporting its tenth CHEVALINE launch. It remains inactive at this time.

- Complex 30 - Complex 30 was constructed in the early 60's as a dual launch pad to support the PERSHING missile program. The US Army launched a total of 49 vehicles from a positioned on or near the pad. The flight test program was completed and the mobile gantry dismantled in 1968. This complex is currently inactive.

- Complexes 31 and 32 - During the last half of 1959 and the first half of 1960 these complexes were built to support testing of the Air Force's MINUTEMAN missile system (see Figures 1-2 and 1-11). Each of the complexes had two pads. Pad A on each was a flat pad and pad B was a ballistic missile silo. By the time they were deactivated in December 1973, a total of 92 MINUTEMAN I, II, and III missiles had been launched from these complexes. The US Army used pad 31A briefly during 1973 to support follow-on testing of the PERSHING IA. A total of twelve PERSHING IA launch vehicle's were launched by active duty units during a two month period. These Complexes are now inactive.

- Complexes 34 and 37 - Started in 1959 and accepted in 1962 and 1963, respectively, these complexes were built by NASA for the SATURN I and IB programs. Complex 34 supported four SATURN I's and three SATURN IB's; while Complex 37 supported a total of eight SATURN launches.

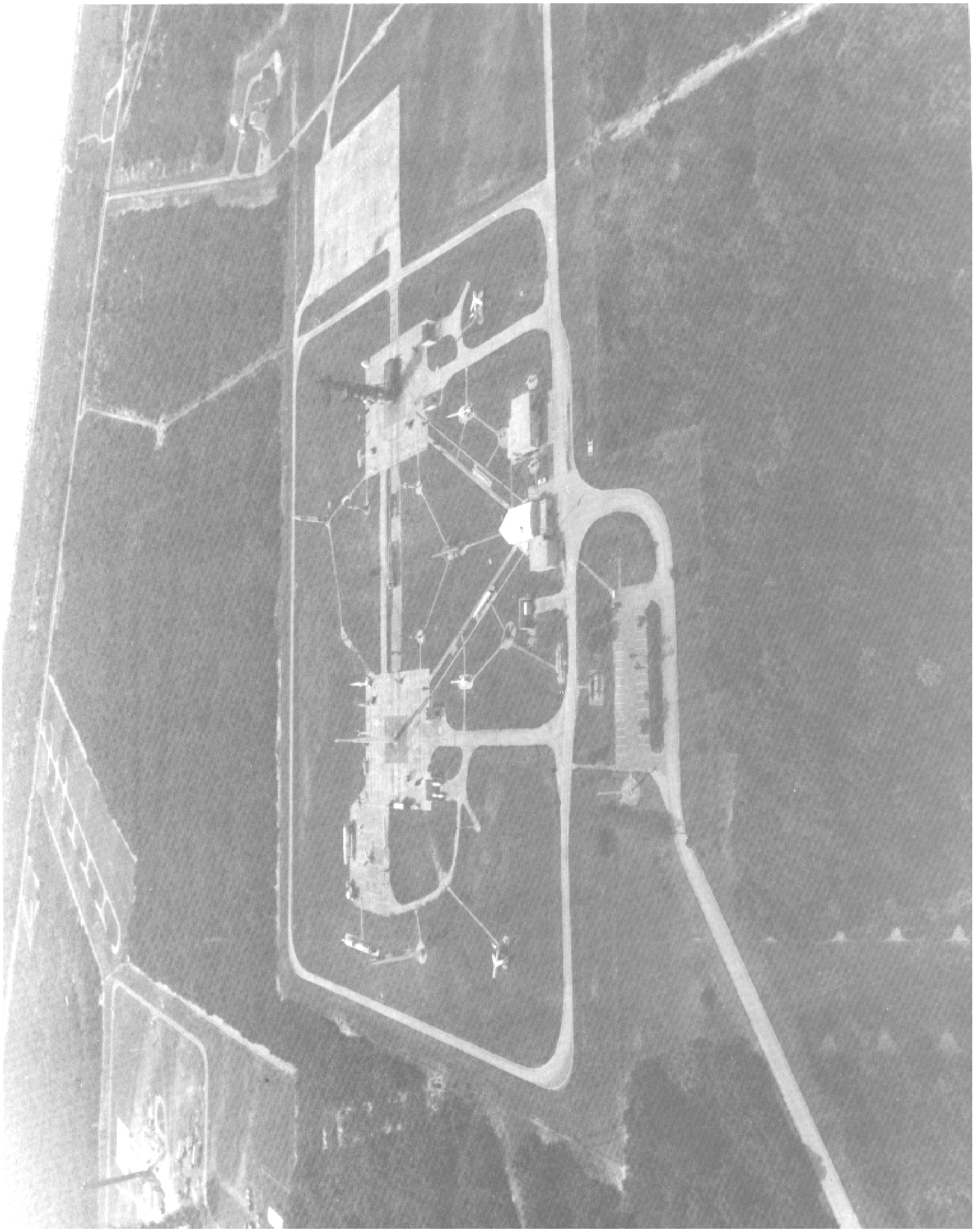


Figure 1 - 14: USAF Space Museum - Complex 26

- The first flight of an unmanned APOLLO lunar module was part of the Complex 37 support. Complex 34 was also considered and rejected for SKYLAB support. Both sites were mothballed and their service structures scrapped in 1972. NASA retains ownership of these sites and uses some the outbuildings for offices. In 1984 Complex 34 was declared a national landmark. Complex 37 has been selected as the launch site for the proposed EELV Boeing Delta IV launch vehicle configuration with the planned first launch scheduled for the third quarter of 2001.

- Complexes 36A and 36B - Now known as SLC-36A and SLC-36B, these pads were built under NASA's sponsorship in 1961 and 1963, respectively, to support the ATLAS/CENTAUR development program (see Figures 1-2 and 1-11). Programs supported under NASA included SURVEYOR, MARINER, PIONEER, INTELSAT, FLTSATCOM, PALAPA, INMARSAT, GE, HOTBIRD, JCSAT, GOES, SUPERBIRD and ECHOSTAR. In 1989, NASA surrendered the site to the AIR Force and General Dynamics, and the site was modified to accept the ATLAS II/CENTAUR. The first commercial ATLAS II/CENTAUR was launched from 36B on December 7, 1991, and the first military launch went from 36A on February 11, 1992. To date, over 100 major launches have been conducted from this complex. Figure 1-15 shows the Complex's current configuration and a line drawing of the Atlas II vehicle.

- Complexes 39A and 39 B - Built on what is now NASA's Kennedy Space Center (KSC) (see Figure 1-16), these sites supported NASA's early manned flight program. Complex 39A was finished October 4, 1965, and Complex 39B slightly more than a year later. Complex 39A supported two unmanned and nine manned SATURN V/APOLLO as well as the SKYLAB space station before undergoing modifications to support the Space Shuttle program. While Complex 39B supported the manned APOLLO 10 mission May 18, 1969, and, after slight modifications, supported three manned SATURN 1B flights to the SKYLAB space station and the APOLLO/SOYUZ rendezvous mission on July 15, 1975. first Space Shuttle flight on April 12, 1981. Complex 39B supported its first launch on January 28, 1986. Both pads are still active.

- Complexes 40 and 41 - Now known as SLC-40 and SLC-41, these complexes were built as part of an Integrate-Transfer-Launch (ITL) facility and are located at the north end of CCAS (see Figures 1-2 and 1-11). The primary facilities in the ITL area include the Vertical Integration Build (VIB) (where the core vehicles and payloads are assembled); the Solid Motor Assembly Building (SMAB) (where the solid motors are built up from their individual segments); the Solid Motor Assembly and Readiness Facility (SMARF) (where the core vehicles and the solids are mated); and the pad's themselves. Figure 1-17 shows the arrangement of the structures in and around the pads and an example of the Titan IV vehicle. When these facilities were initially constructed in the early 60's, they supported the TITAN IIIC vehicle. Since that time, and with required upgrades, they supported the TITAN 34D and TITAN IV. Complex 41 was also the site of two major NASA launches. The 1975 TITAN IIIE/CENTAUR launch series comprising the VIKING missions to Mars and, in 1977, the VOYAGER missions to the outer planets. Deactivated from 1977 to 1986, pad 41 was refurbished and upgraded to support the Titan IV program. Pad 40 was also renovated between 1990 and 1993. Pad 41 has been selected as the future site for the Lockheed Martin proposed EELV Atlas common core vehicle configuration with a

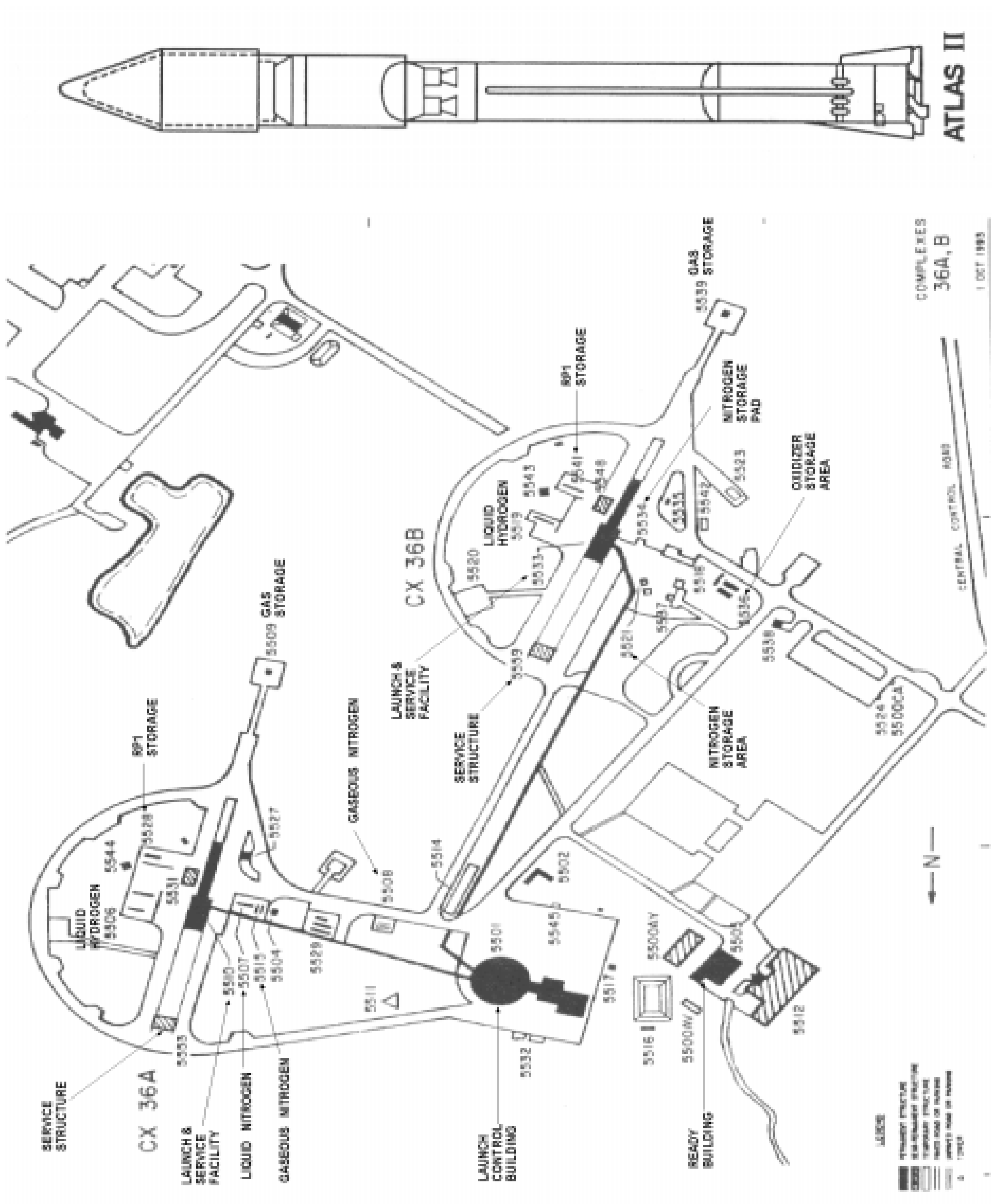


Figure 1 - 15: SLC 36A and 36B with Representative Vehicle

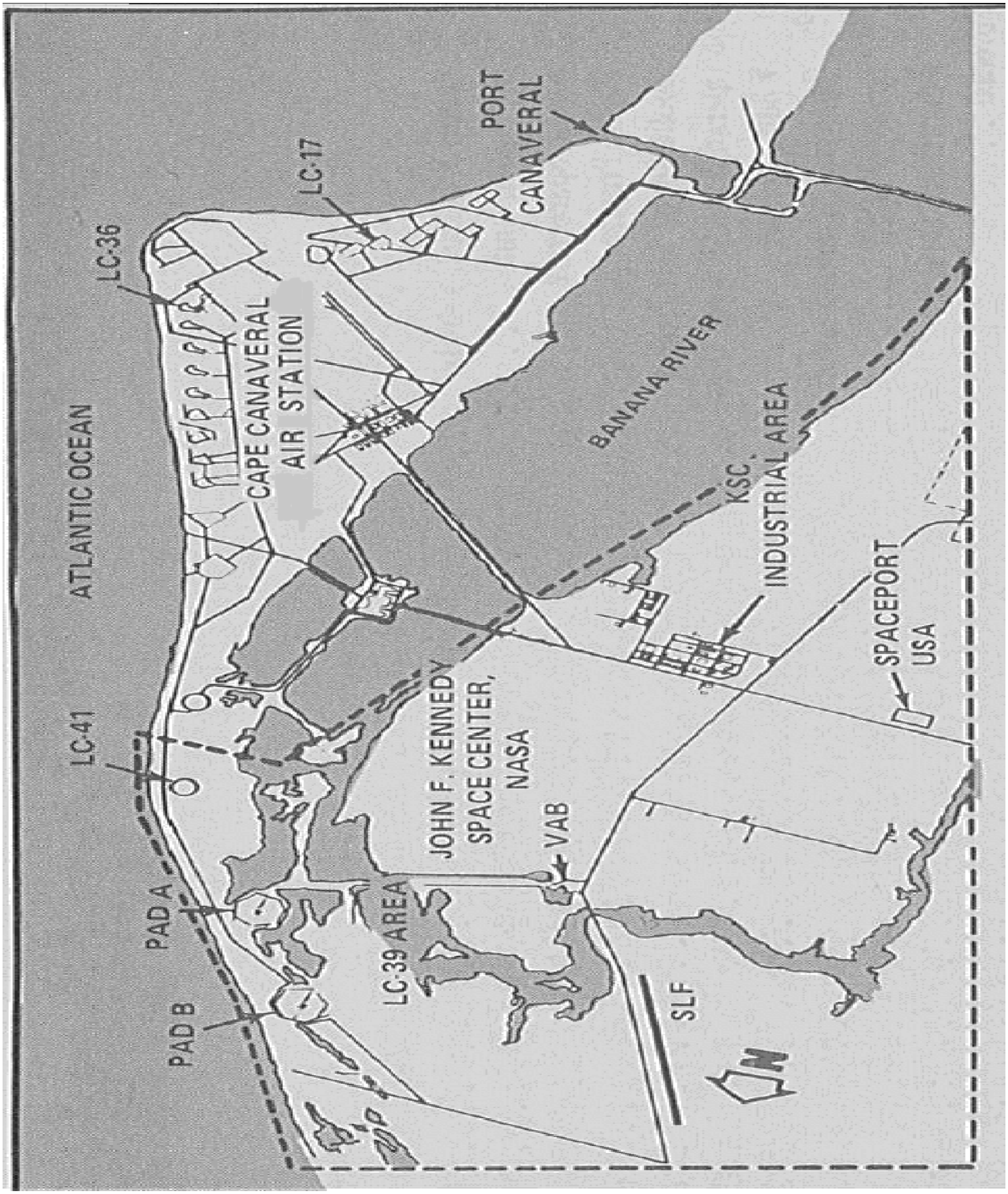


Figure 1 - 16: Kennedy Space Center

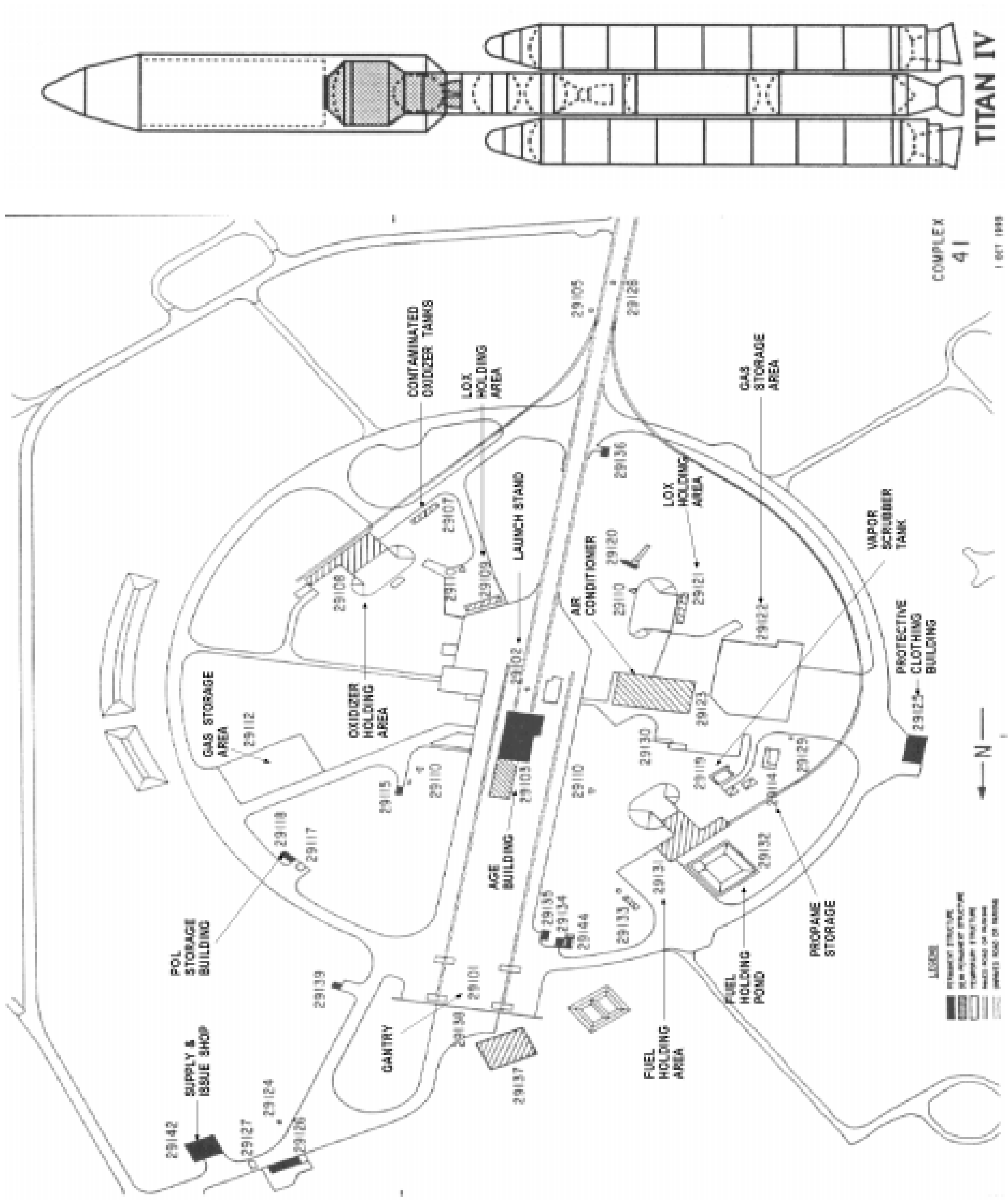


Figure 1 - 17: SLC 41 and Representative Vehicle

planned first launch scheduled for the third quarter of 2001. These sites have supported over 70 missions to date.

- Complexes 43 and 47 - Complex 43 is located just north of Complex 46 on the tip of the Cape. Complex 47 is approximately midway between Complexes 37 and 40 (see Figures 1-2 and 1-11). These complexes support CCAS's weather rocket launches. 4,680 weather rockets were launched from complex 43 from 1962 to 1984. In 1984 the site had to be moved to facilitate the building of complex 46. Thus, in 1984, complex 47 was built to allow the continuation of weather rocket support. Complex 47 has also been the site of several unique missions. In November of 1988, it supported the commercial launch of a single-stage rocket (LOFT-1), and, in October 1992, a student sub-orbital SUPER LOKI weather rocket. Only complex 47 is still active.

- Complex 45 - Complex 45 was reserved for the site from which the ROLAND mobile missiles were to be launched. However, the program was cancelled before any missiles were launched.

- Complex 46 – This dual use launch facility is located on the tip of the Cape (see Figures 1-2 and1-11), Complex 46 was built to service the US Navy's TRIDENT II ballistic missile pad launch series of tests. Between its completion in 1986 and the beginning of the sea-launch tests in 1989, nineteen missiles were launched from this pad. This site underwent major modification in 1997 to construct facilities to support the Spaceport Florida Authority and Lockheed Martin Athena class launch vehicle missions and is currently active.

Because of the large number of facilities on CCAS in addition to the major complexes, the station has been divided into eleven areas with the facilities tied to a coordinate system within each of these areas. Figure 1-18 identifies these areas. Where required for clarification, copies of the expanded maps of these areas have been reproduced and inserted in this document. In addition, the following facility discussions place each site in its respective area for easy identification.

- ESA 60 (Building 54445) - This explosive safe facility was quantity-distance sited for NASA ELV hazardous payload operations, such as ordnance installation and propellant loading, and is located along the east shore of the Banana River at coordinates F-6 in area 3 (see Figure 1-19). Its 6903 ft^2 of floorspace houses two isolated bays, one on either side of a holding area. The facility was mothballed by NASA in the early 90's and most of the test equipment removed.

- Dynamic Balance Lab - The 2250 ft^2 Dynamic Balance Lab (Building 54446), is located just south of ESA-60, at coordinates F-6 in area 3 (see Figure 1-19), it is still used by NASA for spacecraft processing.

- Industrial Area - An expanded view of the Industrial Area (Section 3A of Figure 1-19) is shown in Figure 1-20. Several facilities are prominent in this area. Building 1608, coordinates C-7, is the main fire station. It primarily supports the industrial area and active SLC's but its resources may be deployed as needed anywhere on CCAS or

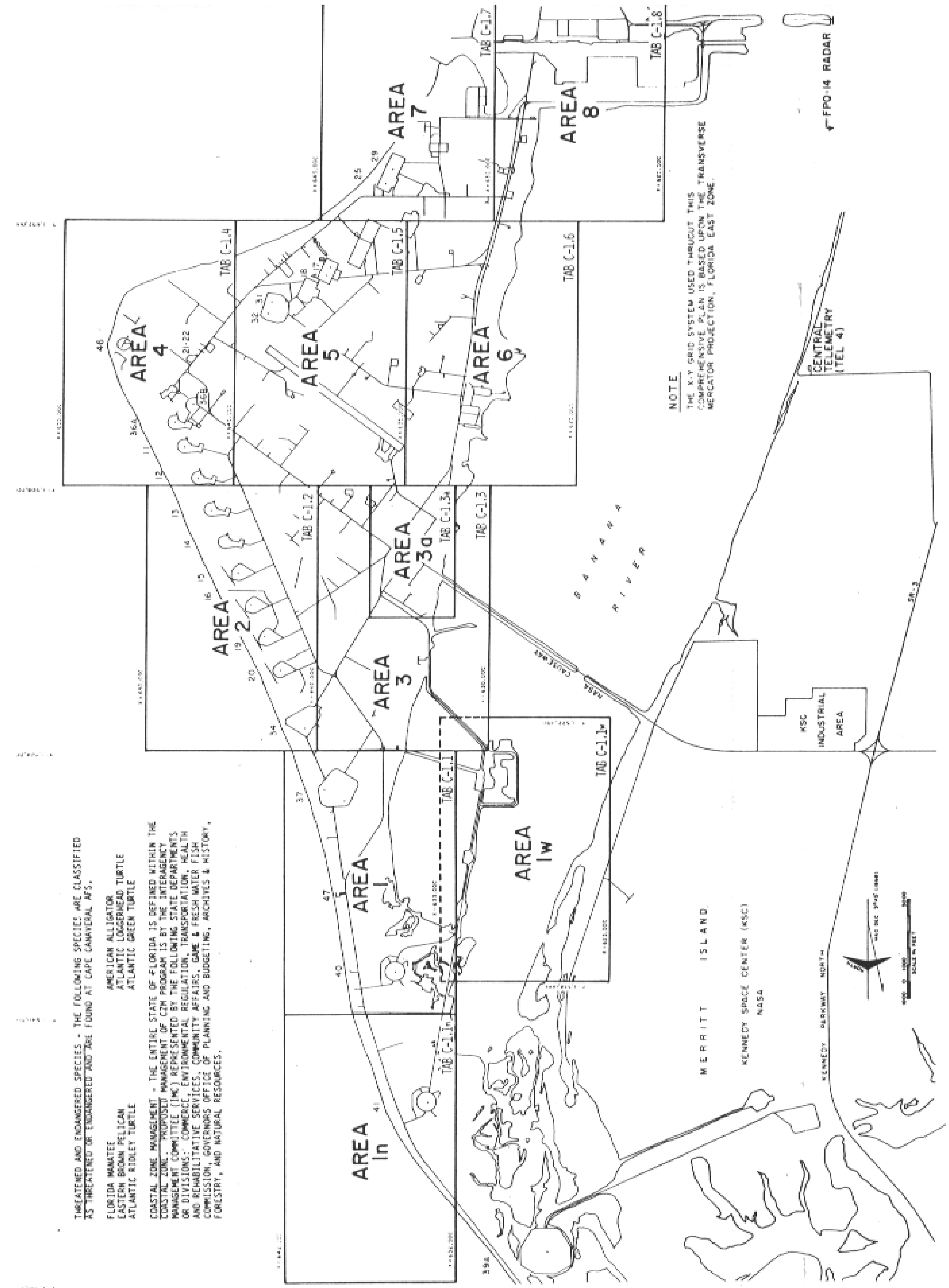


Figure 1 - 18: Breakdown of CCAS by Area

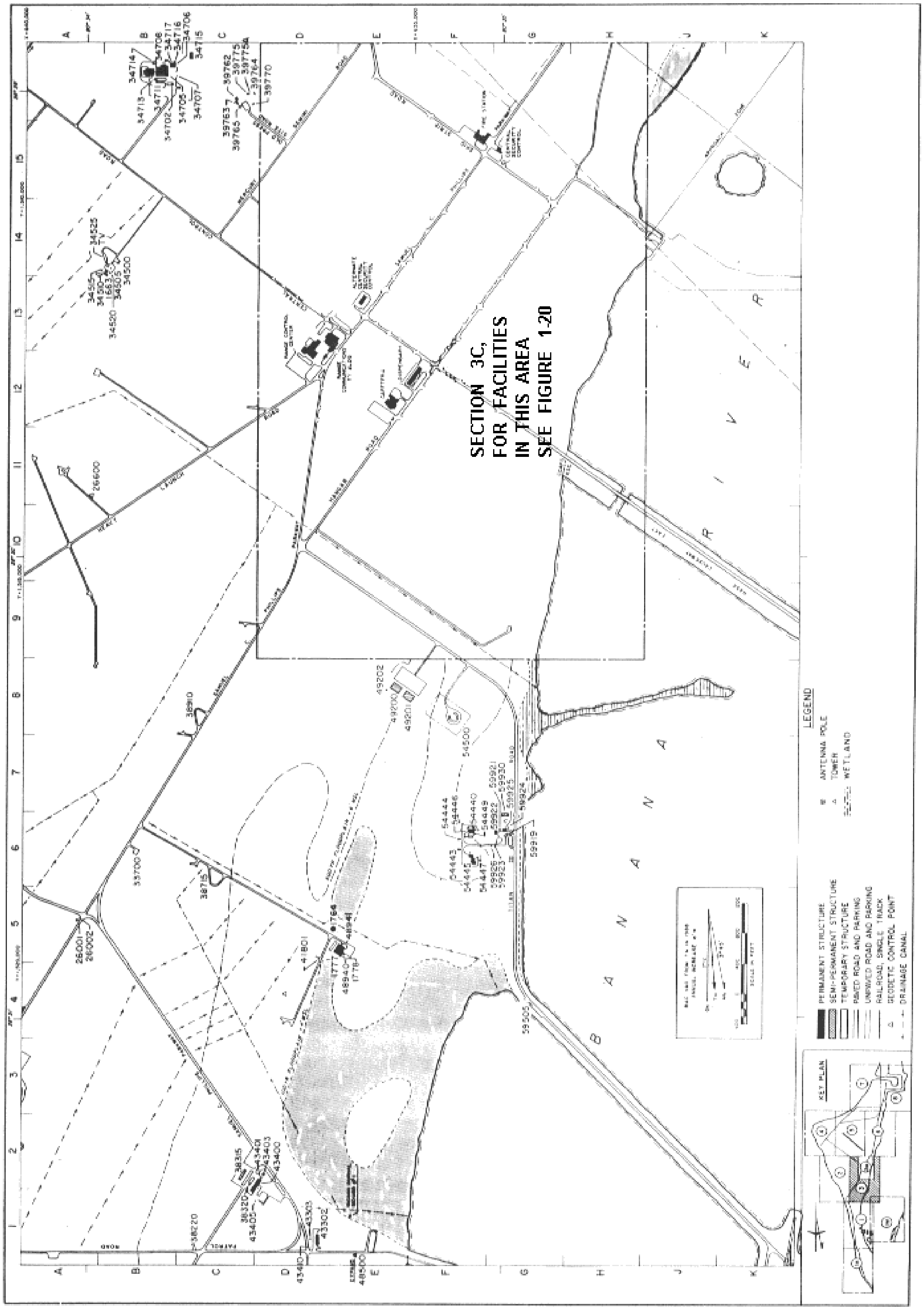


Figure 1 - 19: CCAS Area 3

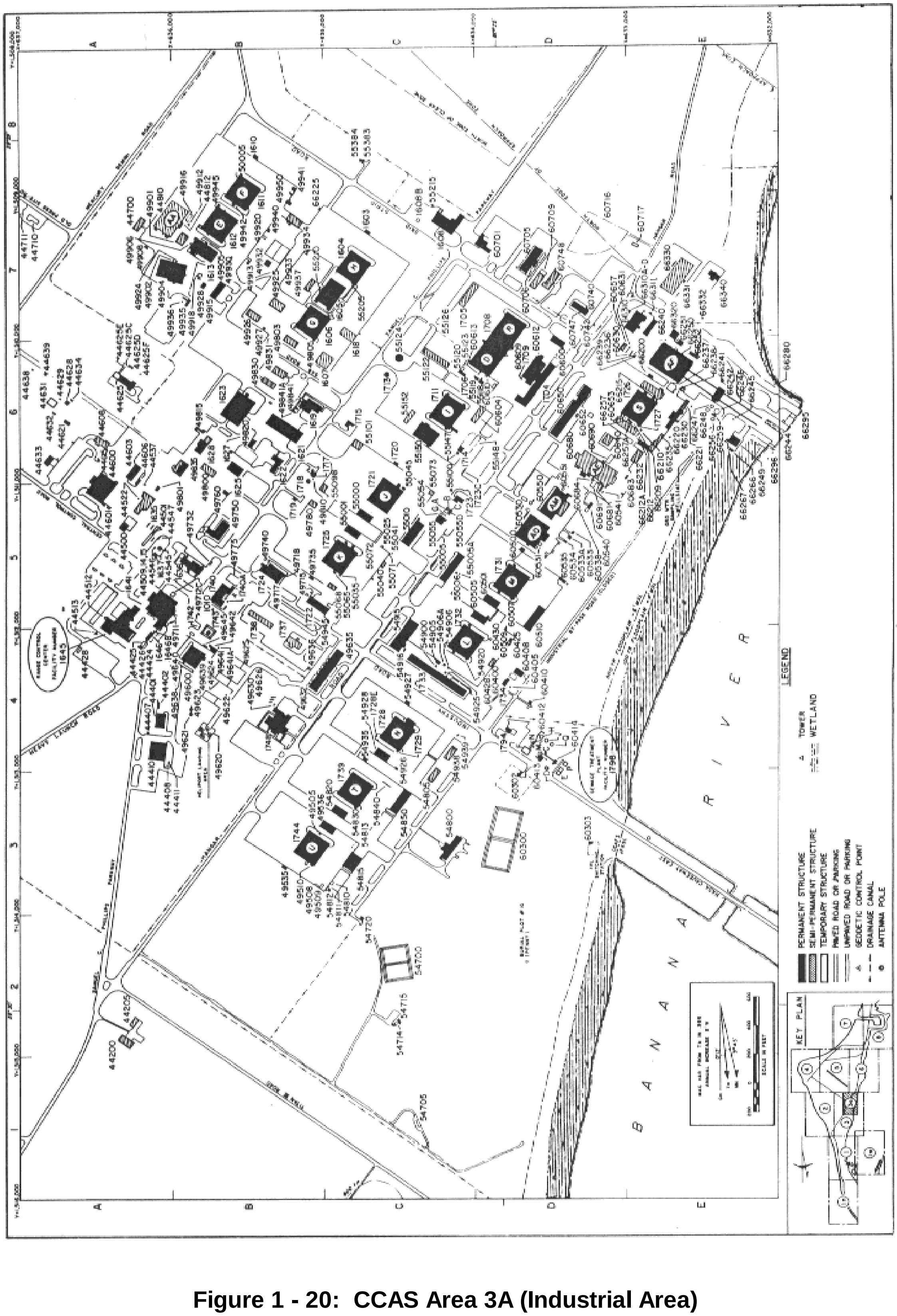


Figure 1 - 20: CCAS Area 3A (Industrial Area)

- KSC, just as KSC's fire station resources may be deployed as needed anywhere on CCAS or KSC. The 34,623 ft^2 X-Y Building #1641, at coordinates A-5, is the Range Communications building. It houses communications terminations and links to all CCAS facilities, instrumentation sites, KSC and other off-range support systems. All ER communications are relayed through this location to the new Range Operations Control Center via fiber optic cable. The 26,733 ft^2 Satellite Assembly Building #49904, coordinates A-7, is used for processing payloads for Delta, Atlas, and other vehicles as scheduled time is available. The 66,170 ft^2 Shuttle Solid Rocket Booster (SRB) Recovery Facility, Hangar AF, building 66250, at coordinates E-6, is the receiving point for SRB's recovered by the SRB retrieval vessels, the Freedom Star and Liberty Star, operated by Lockheed Martin Space Operations. Once removed from the water and transferred to their motor stands at Hangar AF, USBI (company name) personnel begin the SRB refurbishing process. Further refurbishing is done in Hangar N, building 1728, coordinates C-4, and at USBI's KSC facility.

- Area 5 - The expanded view of Area 5 shown in Figure 1-21 identifies the locations of several of the launch complexes previously discussed. In addition, it portrays the 10,000 ft skid strip, facility 50305, where aircraft arrive and depart carrying vehicles, payloads, and other components to be off/on loaded in support of ER test operations. Fuel Storage Area (FSA) #3 is located at coordinates E-15/F-15 adjacent to SLC-17. This storage area has 8 igloos ranging in size from 295 ft^2 to 1595 ft^2 and a 1288 ft^2 magazine for class A, B, and C ordnance storage.

- Area 6 - Three additional fuel storage areas are located in Area 6, see Figure 1-22. These are Fuel Storage Areas 1, 2, and 5. FSA 1 is for liquid fuel and is at coordinates F-9. The tanks in this area, #77615-#77619, each hold 476 barrels of fuel. Tank #77615 contains JP-5 and the other tanks contain RP-1. FSA 2, at coordinates D-5, is a solids storage area with a 3345 ft^2 magazine for missiles, two 1711 ft^2 magazines for motors, and 7 storage igloos from 350 ft^2 to 1907 ft^2 for pyrotechnics, boosters, and other explosives. FSA 5, at coordinates B-10/C-10, is a solids storage area with 4 magazines for class A, B and C ordnance and missile storage. Facility 80700, at coordinates F-7, is a liquid propellant disposal facility for contaminated hypergolic fuels.

- Area 7 - The communications receiver antennas and building are located in Area 7 at coordinates K-2 through K-6, see Figure 1-23. The receiver building, #1102, covers 2674 ft^2 and houses 10 each HF8050A receivers, 16 HF651F-1 receivers, and several UHF/VHF transceivers used for communications with all downrange support sites, ships, and aircraft worldwide. The antenna field contains 2 tri-nested rhombic antennas, 5 log periodic antennas, and 2 discone antennas. UHF and VHF are mounted on the building itself.

- Area 8 - The Range Operations Control Center (ROCC), #81900, is located in Area 8 (Figure 1-24) just to the north of the Trident Turning basin on the access road to the receiver site at coordinates A-4. This 127,000 ft^2 facility (Figure 1-25) provides a next generation replacement for the old Range Control Center (Figure 1-19, coordinates A-4/A-5, #1645). The ROCC is the primary ER safety command and control point for commercial and governmental launches. It provides concurrent operational support

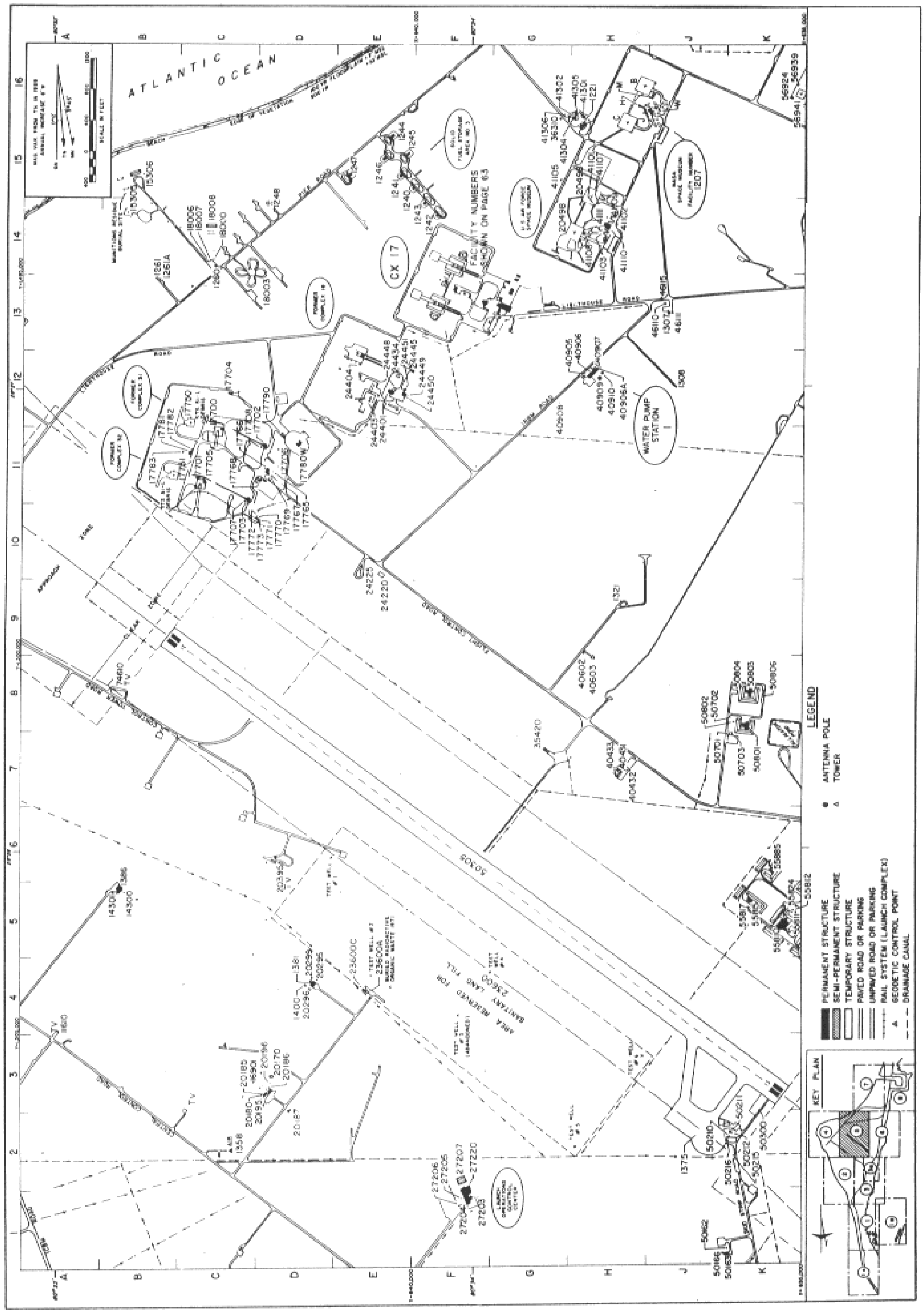


Figure 1 - 21: CCAS Area 5

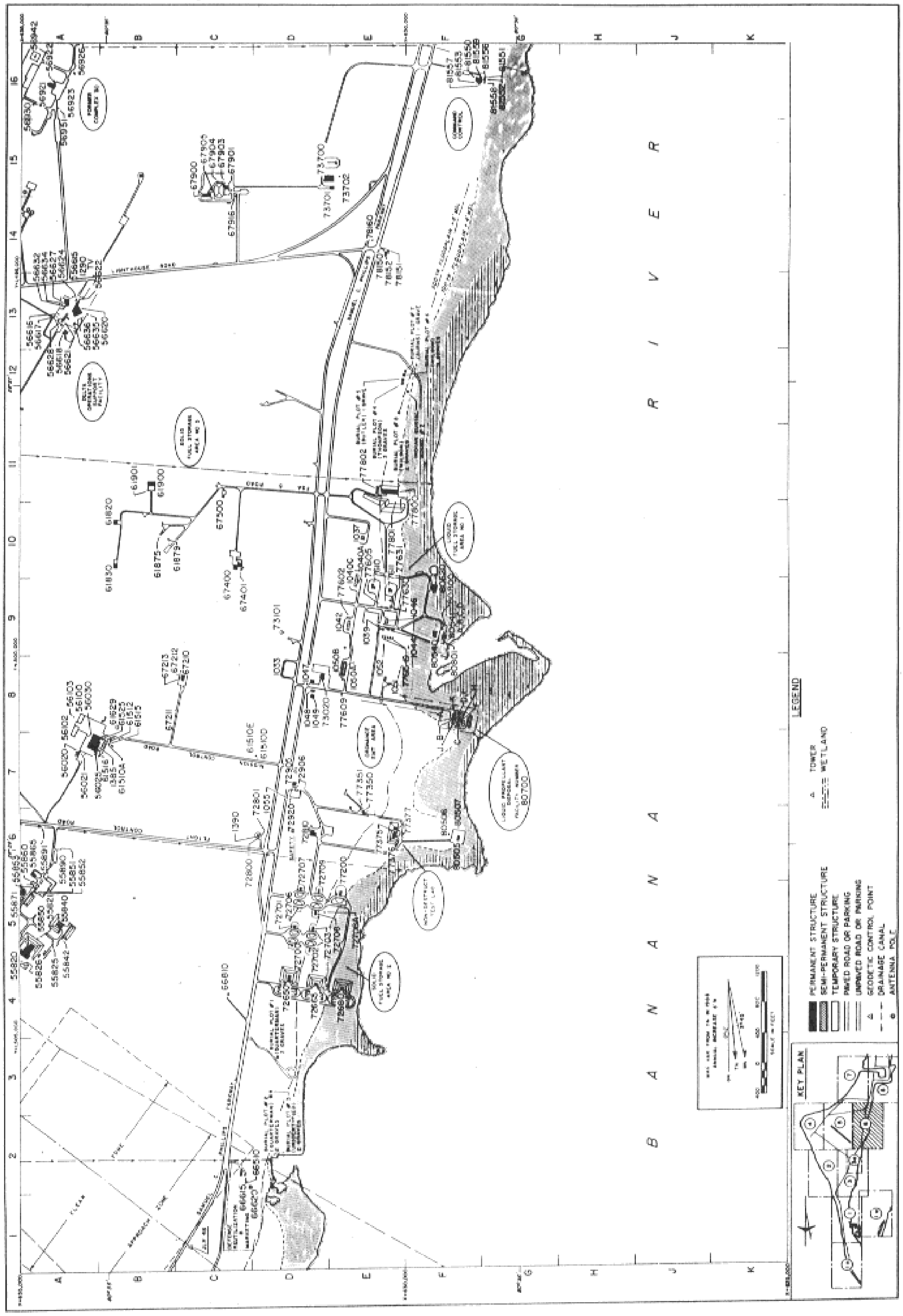


Figure 1 - 22: CCAS Area 6

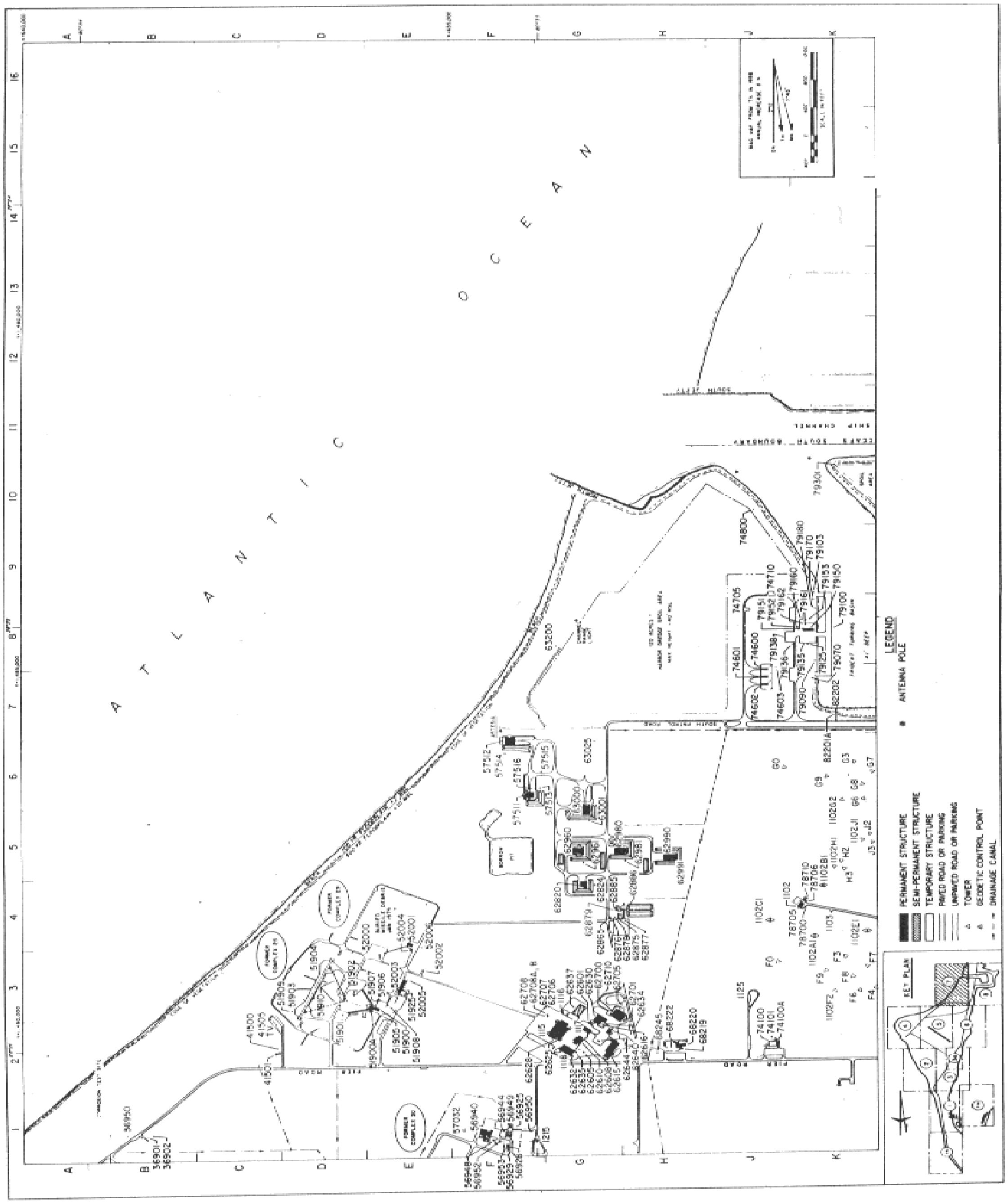


Figure 1 - 23: CCAS Area 7

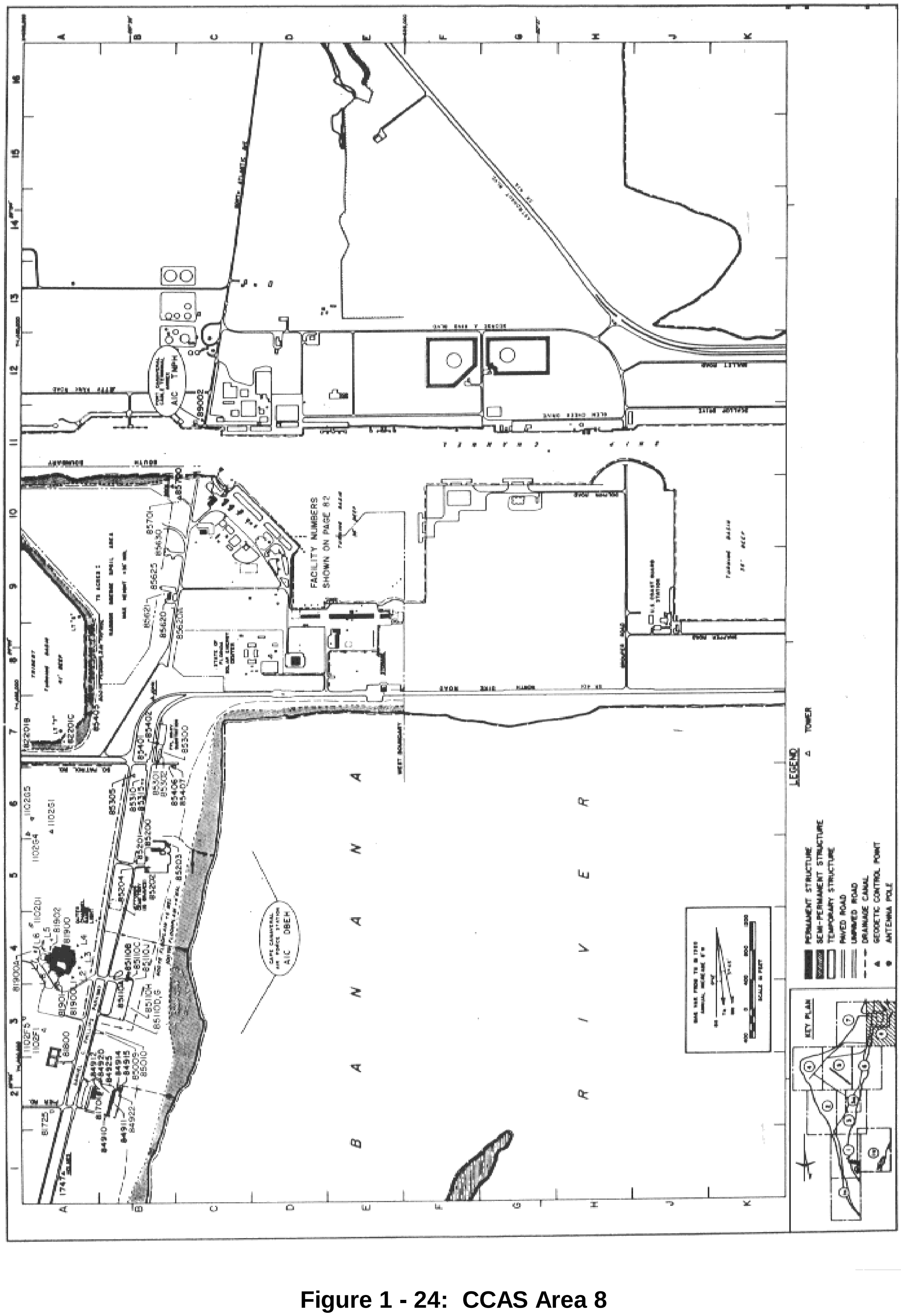
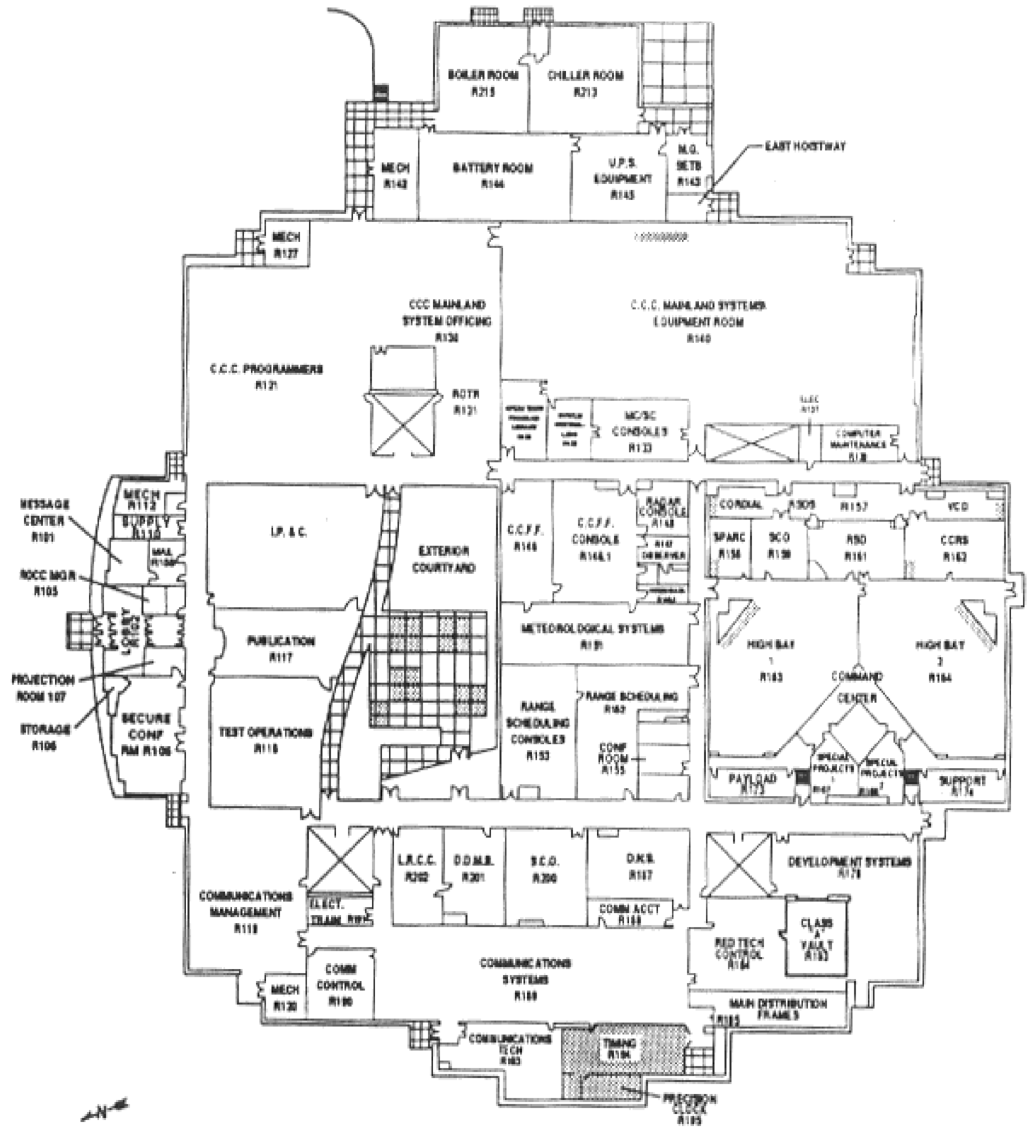


Figure 1 - 24: CCAS Area 8



LEGEND:

Represents multiple Count/Timing panels

NOTE: REFER TO THE FOLLOWING:

DRAWING TREE	598211
PARTS LIST AND ASSEMBLY	598311
BLOCK DIAGRAM	635745
CONNECTION DIAGRAM	598312

Figure 1 - 25: Range Operations Control Center

for security protection, range scheduling and planning, surveillance control, vector control, weather measurement and analysis, facilities communications, training, and maintenance actions. Fire Station #3, building #85010, is located at coordinates B-3. It is just across the Parkway from the entrance to the ROCC. Just south of the Fire Station is Fuel Storage Area #4, tank #85110, coordinates B-3/B-4. FSA 4 is a controlled parking area for transportable liquid storage tanks. NASA normally maintains a tank (#85110G) capable of holding 13,500 gallons of liquid nitrogen at this location.

1.2.2 Local and Off-Range Instrumentation

This section contains detailed descriptions, to include performance characteristics, coverage limits, and operating frequencies, of the instrumentation systems generally used in support of ER launch operations:

Table 1 - 2: ER Site Designations and Locations

Designation	Location
00	Patrick Air Force Base
01	Cape Canaveral Air Station
12	Ascension Auxiliary Airfield
19	Kennedy Space Center
28	Jonathan Dickinson Missile Tracking Annex
35	Cocoa Beach Ocean Tracking Annex
36	Melbourne Beach Optical Tracking Annex
53	Argentia, Newfoundland
59	Malabar Transmitter Annex
86	Wallops Island, VA
91	Antigua Air Station

1.2.2.1 Radar Systems

The ER uses six classes of metric tracking C-band radars comprising ten radars with the type of radar, location, and number designation as shown:

- AN/FPQ-14

Kennedy Space Center	19.14
Patrick Air Force Base	0.14
Jonathan Dickinson Missile Tracking Annex	28.14

Antigua Air Station	91.14

- AN/FPQ-15

Ascension Island	12.15

- AN/TPQ-18 (M)

Ascension	12.18

- AN/FPS-16 (M)

Cape Canaveral Air Station	1.16

- AN/MPS-39 (Multiple Object Tracking Radar) (CCAS) 1.39

- Mobile C-Band Radar (MCBR)

Kennedy Space Center	19.17
Argentia, Newfoundland	53.17

In addition, the ER uses three NASA-operated radar tracking systems; an AN/FPQ-6 and two AN/FPS-16s at Wallops Island, Virginia.

Figure 1-26 identifies the locations of all of the radar systems typically supporting ER missions. Figure 1-27 shows some of the up-range radar antenna systems; while Figure 1-28 shows some of the downrange systems.

The ER radar network provides:

- Real-time target position
- Trajectory and signature data
- Aircraft vectoring

All tracking radar systems are capable of beacon and skin (echo) tracking. The AN/FPQ-14 and AN/TPQ-18s are capable of tracking in both vertical and circular polarization modes. The AN/FPQ-15 is capable of tracking in either right-hand or left-hand circular polarization modes, and the remaining ER radar tracking system in linear polarization.

The AN/FPQ-14's and the two Ascension radars have on-axis tracking capabilities. This capability permits the radar antennas to be computer driven using data from a predetermined orbit-generator program. The orbit-generator program allows real-time adjustments to be made in the orbital equations in response to target behavior sensed by the tracking portion of the radar, thereby closing the tracking loop through the computer. These orbital equations are automatically adjusted at intervals and in increments best suited to optimize the antenna drive signals for the dynamics of the target being tracked.

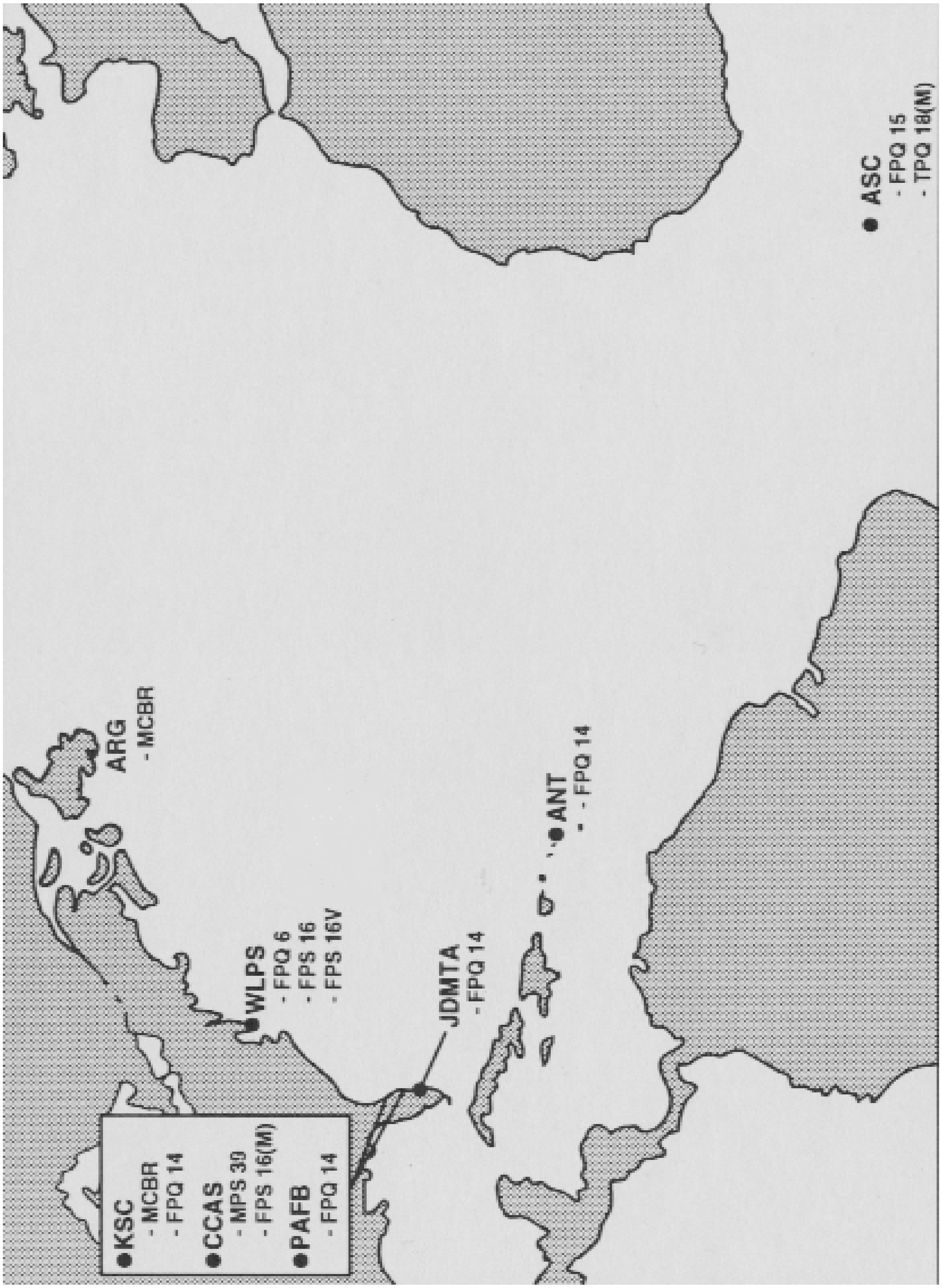
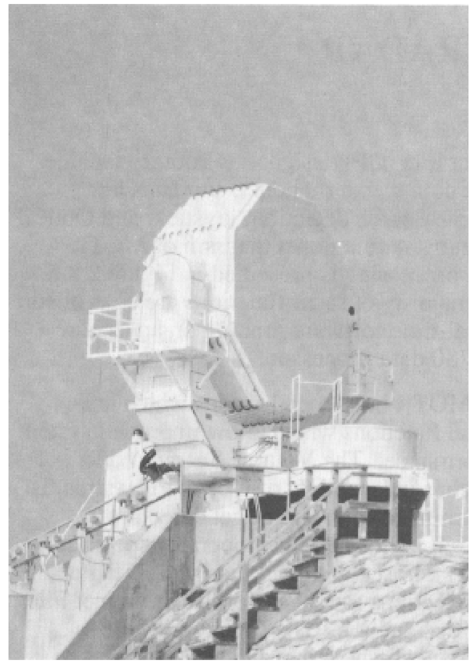
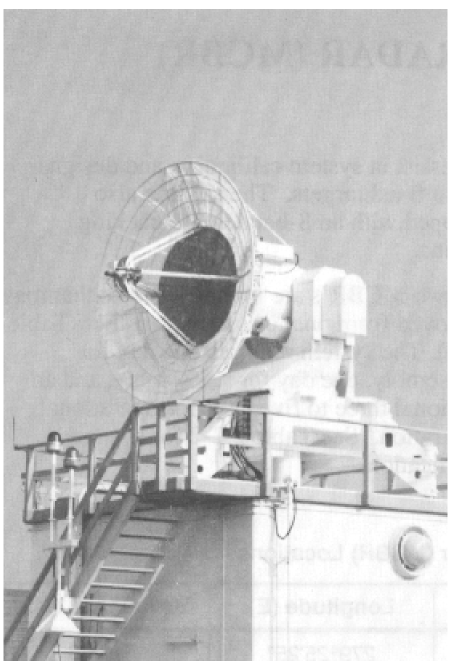


Figure 1 - 26: Locations of Typical ER Radar Mission Support

CCAS 1.16



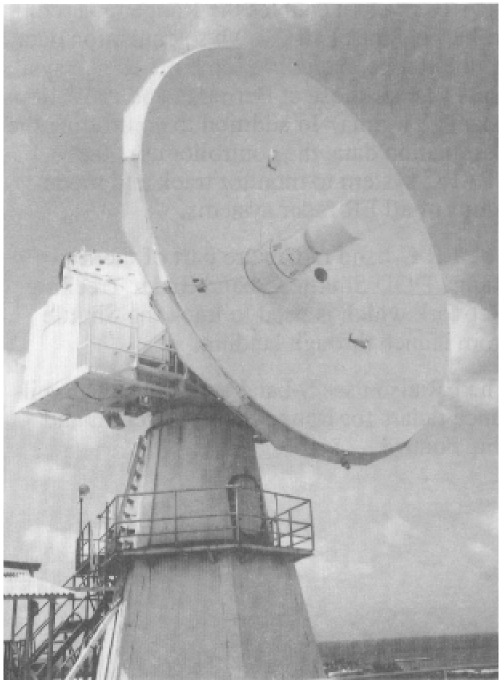
CCAS 1.39



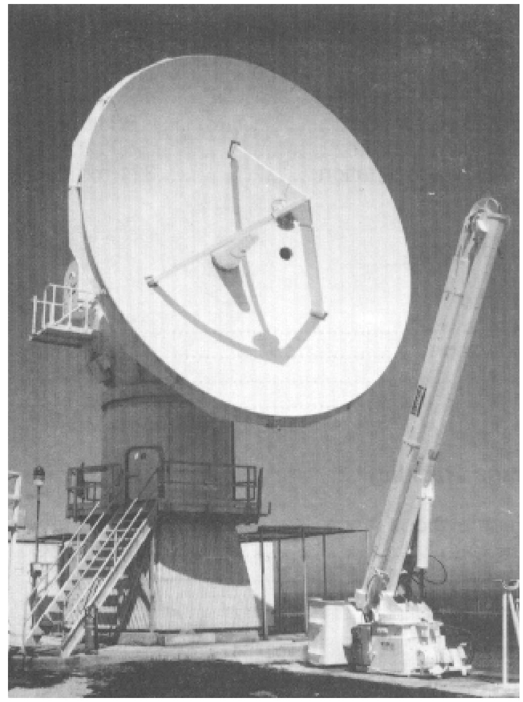
KSC 19.17

PAFB 0.14

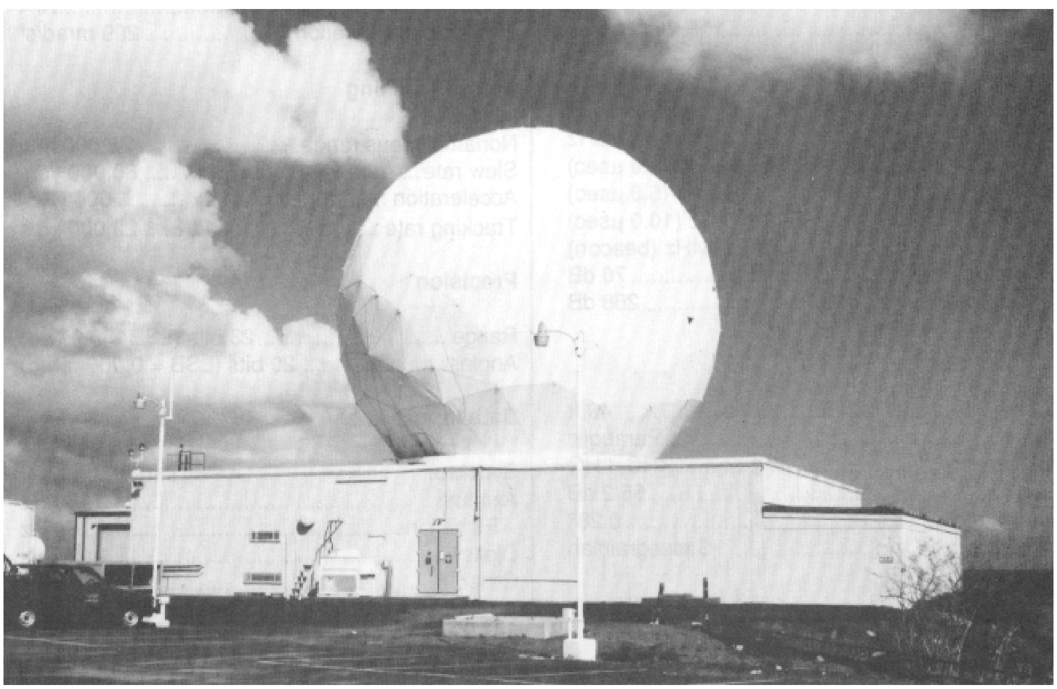
Figure 1 - 27: Uprange Radar Systems



Antigua AS 91.14



Ascension AS 12.18



Ascension AS 12-15

Figure 1 - 28: Downrange Radar Systems

In addition, all characteristics of the radar antenna are programmed in the computer and used to compensate for antenna drive errors. Consequently, the antenna's axis is precisely maintained on those targets that do not have large accelerations. Other ER radars operate in auto-track mode and respond directly to radio frequency (RF) off-axis antenna drive errors.

In the free-fall, on-axis mode, radars can track free-falling targets that are not subject to large drag forces, such as satellites or missile bodies in exoatmospheric flight. The salient feature of this mode is that the dynamic equations use accelerations computed with a gravitational model, thereby increasing smoothing effectiveness.

The powered-flight, on-axis mode is suitable for tracking targets not in free fall, including thrusting missiles, since the dynamic model does not assume orbital constraints.

The ER C-band radars are calibrated twice a week using skin and beacon tracking orbiting satellites.

Operational control and coordination of the radar resources is provided by the Single Point Acquisition and Radar Control (SPARC) System located at Cape Canaveral Air Station. The SPARC System enables the range radar controller to control all 2400 b/s acquisition data on the range, including some off-range systems such as those at Wallops Island, Virginia. In addition to controlling the designation data, the controller uses the SPARC system to monitor track and mode status of all ER radar systems. (See Table 1-3.)

The ER C-band radar systems are part of the ten-Range DOD Shuttle C-band Radar Tracking Network that is used to track the Shuttle from launch through landing.

The ER also uses S-band and X-band surveillance radar systems for Range Safety aircraft and ship control.

Table 1 - 3: ER Fixed, Mobile and Transportable Radar System Statistics

ER ID No.	Radar	Wave Length Band	Peak Power Output (Watts)	Pulse Rate Frequency (pps)	Beam-width (deg.)	Antenna Size (Feet)	Antenna Gain (dB)	Max-Range (NM)	Range Accuracy (Meters) (Ft)	Angle Accuracy	Slewing Rates (yds/sec)
0.14	AN/FPQ-14	C	2.5M	160, 320, 640	.38	29	53	32K	18	.07-.10	80K
19.14	AN/FPQ-14	C	2.5M	160, 320, 640	.38	29	53	32K	18	.07-.10	80K
28.14	AN/FPQ-14	C	2.5M	160, 320, 640	.38	29	53	32K	18	.07-.10	80K
91.14	AN/FPQ-14	C	2.5M	160, 320, 640	.38	29	53	32K	18	.07-.10	80K
12.15	AN/FPQ-15	C	2.5M	160, 320	.28	40	55.2	32K	-	-	80K
1.16	AN/FPS	C S-Band Angle	1M	160, 640	1.2	12	44	32K	.97 yd	.006mrad	257.8mrads AZ 230mrads EL
12.18	AN/TPQ-18	C	2.5M	160, 320	.41	29	51	32K	.97 yd	.006mrad	175mrads AZ 90mrads EL
19.17	MCBR	C	1M	160, 640	1.2	12	44		.97 yd	.006mrad	480mrads AZ 500mrads EL
53.17	MCBR	C	1M	160, 640	1.2	12	44	32K	.97 yd	.006mrad	480mrads AZ 500mrads EL
1.39	AN/MPS-39 MOTR	C	800 KW	20, 40, 60, 80, 160, 320, 640 1280	1	12	46 Directory -26 1st Sideband	8192 KYds	-	-	800 mrads AZ 300 mrads EL
1.60L	Surveillance	S	6KW	400, 1000	-	-	27	-	-	-	-
1.8	Surveillance	X	10KW	600, 1200	-	8 ft Slotted Line	31	-	-	-	

1.2.2.2 Optics

The ER optics capabilities include metric, engineering sequential, and documentary imagery. Metric optic systems provide two-dimensional position-versus-time data; these systems include Intercept Ground Optical Recorders (IGOR), Advanced Transportable Optical Tracking Systems (ATOTS), tracking cine-theodolites, fixed-site telescopes and laser imaging system. Engineering sequential imagery provides mission event-versus-time data such as umbilical disconnects, hold-down release, engine ignition, liftoff, and booster separation. These data are produced for range users. Documentary imagery is used primarily for historical documentation, safety investigation and public information purposes; it is not necessarily launch related nor time annotated. Documentary coverage provides a record of such events as transport, assembly, erection, checkout, payload closeout, and launch of space vehicles and systems. All mission-related optical coverage on F-1 day and launch day is coordinated through and monitored by the Photo Control Console (PCC) located in Building 44410 at CCAS. The console is manned at the beginning of the range count and remains manned through data retrieval. Figure 1-29 shows the locations of those optic systems that are available to provide ER mission support.

1.2.2.2.1 Metric Optics

ER metric optics are divided into fixed and mobile tracking instruments. ATOTS's, Mobile IGOR's (MIGORS's), cinetheodolites, and fixed-site telescopes are manually or computer-driven to track moving targets (see Figure 1-30). Encoders attached to the mount axes convert the mount's pointing information to digital data for recording on 9-track computer tape at the Central Computer Complex (CCC) or to alpha-numerics for recording on a video cassette. The encoders are calibrated and the mount errors estimated by a least-squares reduction of pointing measurements to known celestial objects.

The ER has 24 Universal Camera Sites (UCS) that can accommodate most of the range mobile optics systems. These systems include the Contraves cinetheodolites, mobile tracking telescopes, Kineto Tracking Mounts (KTM's), and Intermediate Focal Length Optical Trackers (IFLOT's). Three fixed, long focal length tracking telescopes (ROTI) are also in use at Cocoa Beach, Patrick AFB, and Melbourne Beach, Florida (see Figures 1-30 and 1-31).

The most significant upgrade for all metric optical systems is the installation of a new site computer system and generic software package. This upgrade allows self calibration for each unit, enhancing optical system accuracy as well as increasing system reliability.

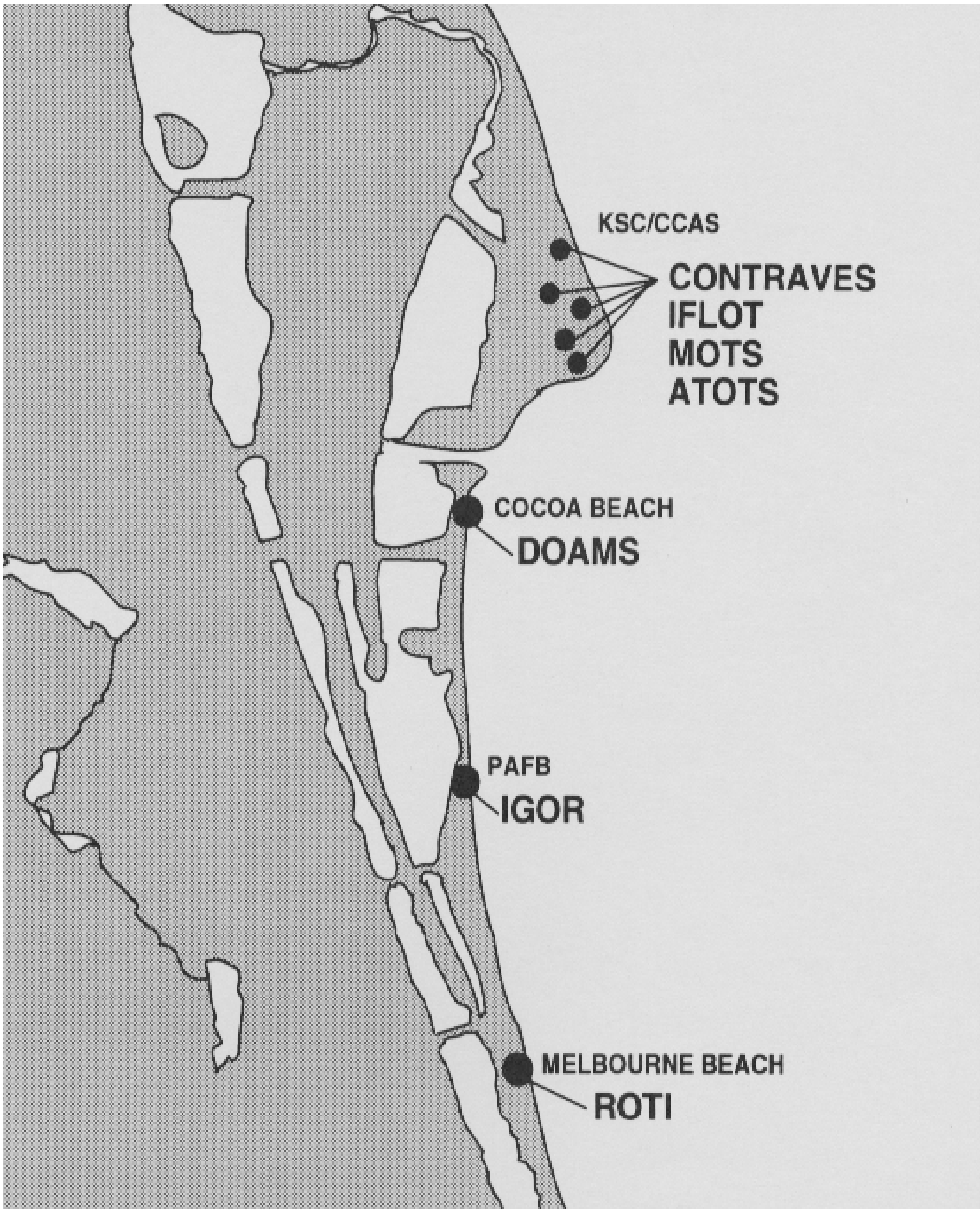
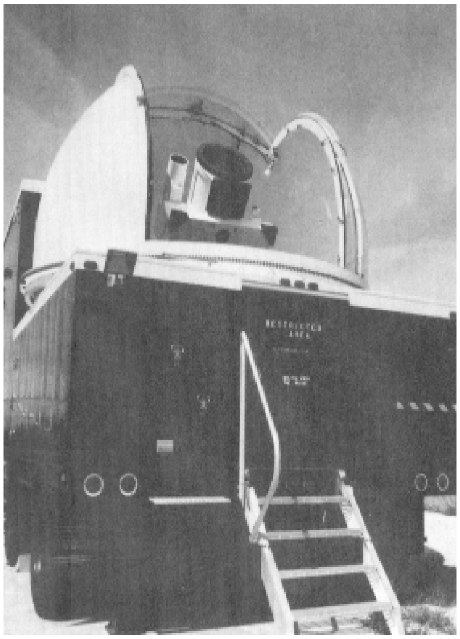
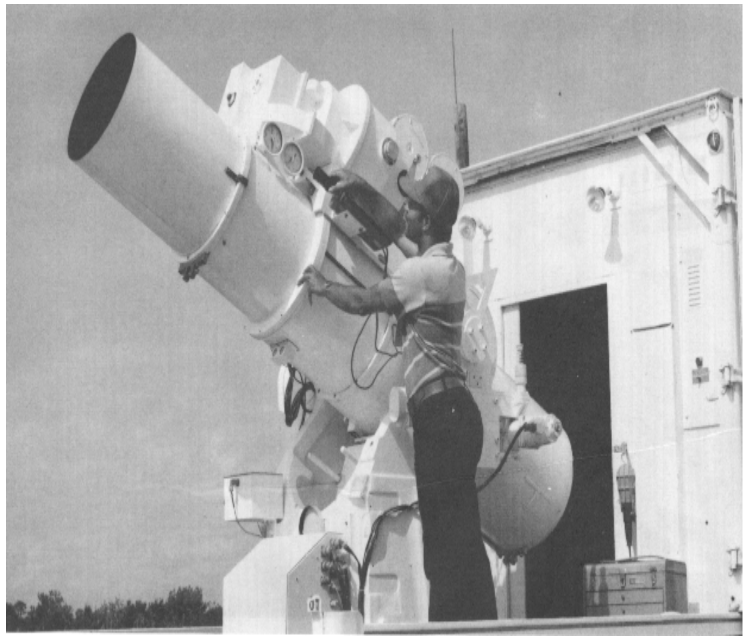


Figure 1 - 29: Location of Typical ER Optical Systems Mission Support

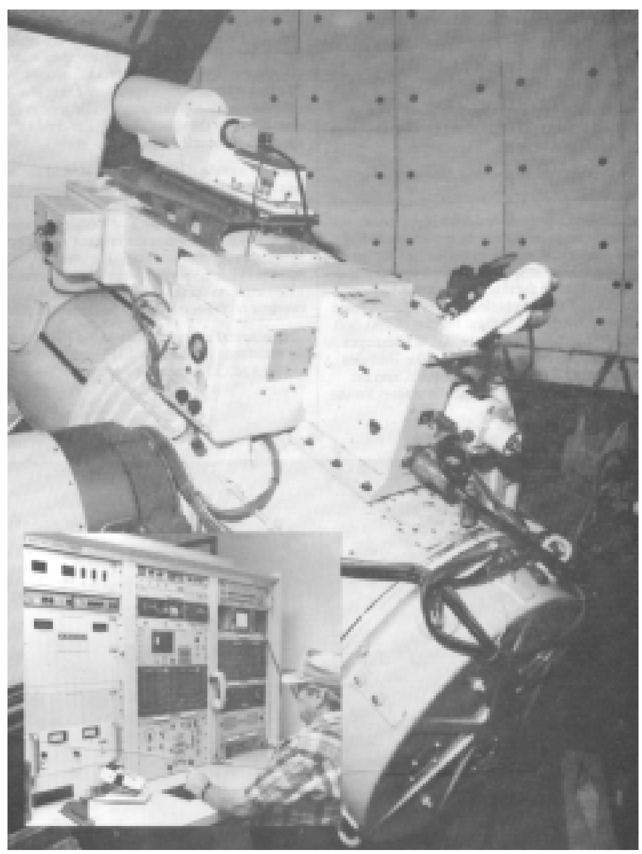


ATOTS



MIGOR

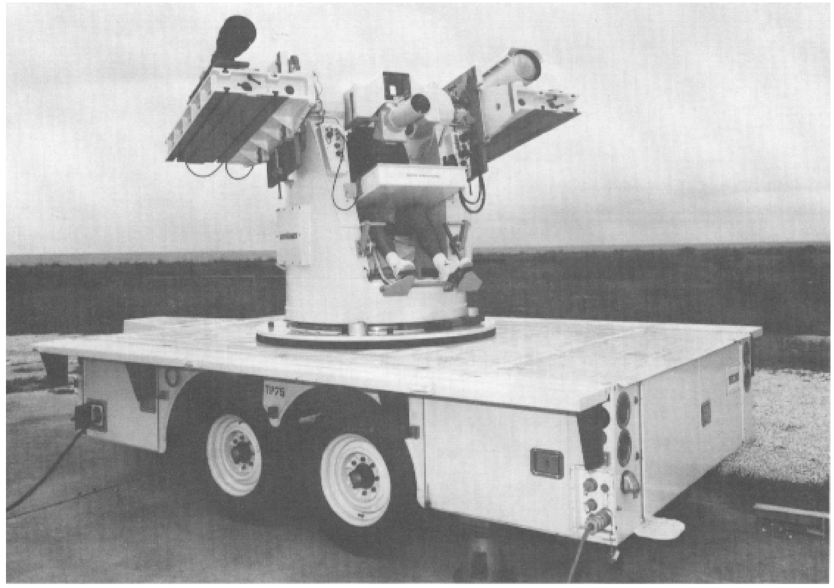
Cinetheodolite, Contraves Model 151



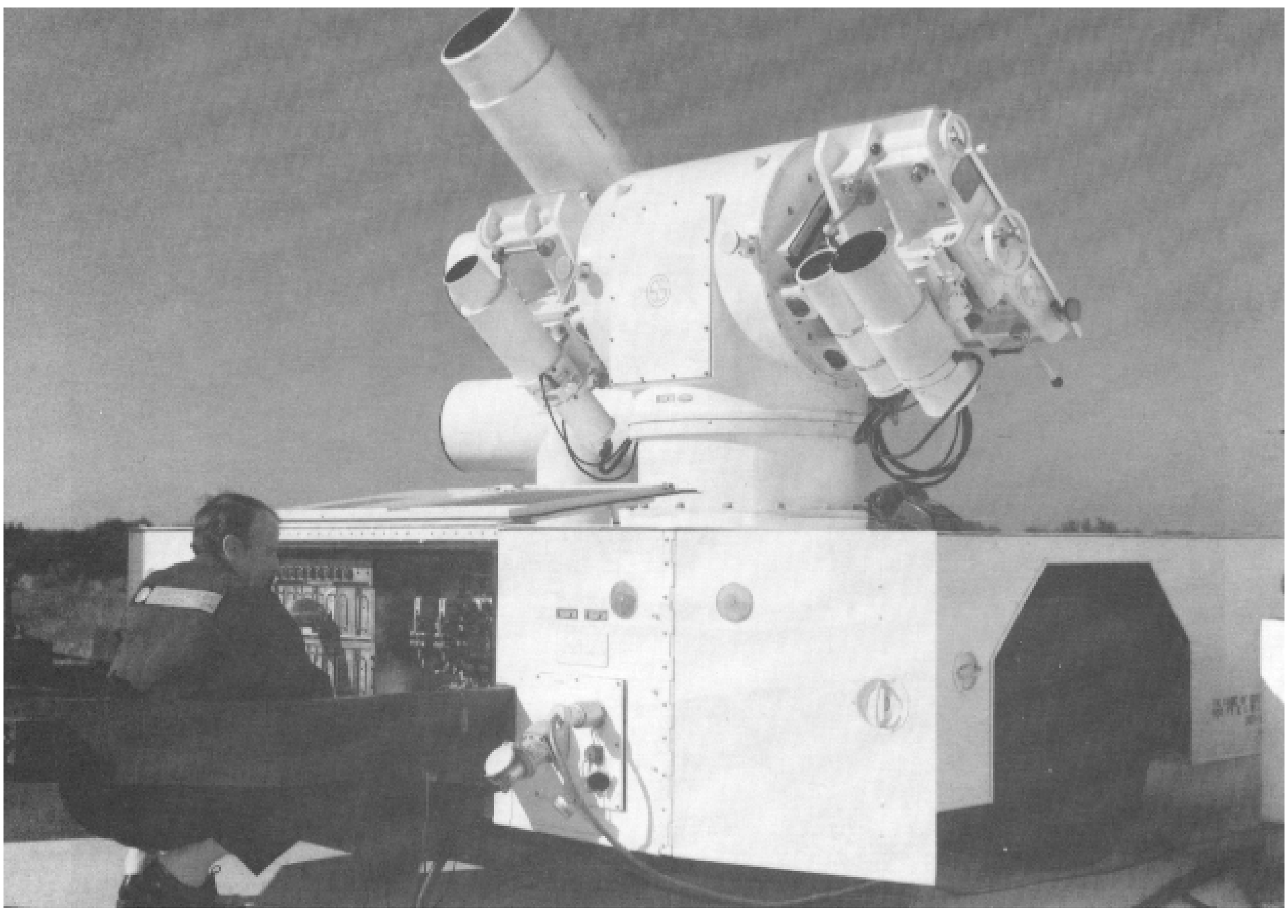
ROTI

Figure 1 - 30: Representative Range Optical Sensors

IFLOT



KTM



MOTS

Figure 1 - 31: Representative Range Optical Sensors

1.2.2.2.2 Engineering Sequential and Documentary Optical Trackers

The range uses tracking mounts and tracking telescopes for engineering sequential coverage. Non-metric Intermediate Focal Length Optical Tracker (IFLOT), Mobile Optical Tracking System (MOTS), and Kineto Tracking Mounts (KTM) are used for both engineering sequential and documentary optics at present (see Figures 1-30 and 1-31).

The range has numerous motion picture and still cameras available for engineering sequential and documentary photography. Units include 16-mm, 35-mm, and 70-mm motion picture cameras and various types of still cameras. A number of video cameras, both vidicon and CCD-based, as well as video recorders are available. All of the non-metric trackers are capable of being configured with any combination of the sensors mentioned above as well as various lens configurations.

1.2.2.2.3 Engineering Sequential and Documentary Cameras

The ER has a large stock of standard motion picture and video cameras to meet the diverse requirements of launch programs. These cameras include standard 16-mm and 35-mm motion picture cameras, special square-format 70-mm motion picture cameras, and both black and white and color video cameras, as well as video recorders. A number of still cameras are also available. Engineering sequential data differs from documentary data by the introduction of timing on the film or video record to provide for an event sequence analysis.

More than 200 motion picture cameras in 16-mm, 35-mm, and 70-mm format are available for general range use. They support DOD and NASA launch and non-launch photo requirements; they operate over a wide range of frame and shutter rates. Using internal/external magazines containing from 100 to 1,000 feet of film and various combinations of lenses and accessories, these cameras meet a broad range of requirements. (see Table 1-4)

Table 1 - 4: Photo Optical Systems

Location	Quan-tity	System Type	Track Modes	Tracking Rates	Frame/Shutter Rate (F/S)	Film Type	Lens Focal Length	Tracking Limits (degrees) Elevation	Tracking Limits (degrees) Azimuth
Mobile	6	Contraves Model 151	Slave	30 deg/sec	5,10,20,30	35mm/SVHS	60 inch 120 inch	-5 to 89	360
Melbourne Beach	1	ROTI	Slave	10 deg/sec	12 to 96	35/70mm	100-500 inch	-5 to 85	720
Cocoa Beach	1 2	DOAMS	Slave	10 deg/sec	12 to 96	35/70mm	100 inch 200 inch	-10 to 190-	720
Patrick AFB Mobile	1 2	IGOR	Slave	10 deg/sec	12 to 96	35mm 35/70 mm	90,180,360 and 500 inches	-3 to 70	270
Mobile	2	ATOTS	Slave	10 deg/sec	12 to 96	35/70mm	180, 400 and 500 inches	-2 to 91	706

ROTI: Recording Optical Tracking Instrument
DOAMS: Distant Object Attitude Measurement System
IGOR: Intercept Ground Optical Recorder
ATOTS: Advanced Transportable Optical Tracking System

1.2.2.3 Telemetry Systems

The ER land-based telemetry facilities consist of two mainland and two downrange stations. The following paragraphs describe basic system configurations, capabilities, operational concepts, operational limitations, and instrumentation upgrade plans for each of the four stations. Figure 1-32 shows the location of those telemetry systems that provide ER mission support.

Telemetry systems are installed at:

- KSC Tel-4 (Station 19)
- JDMTA (Station 28)
- Antigua (Station 91)
- Ascension (Station 12)

1.2.2.3.1 Tel-4

Tel-4 is within the boundaries of the Kennedy Space Center (KSC), Merritt Island, Florida and is designated Tel-4/KSC, Station 19 (see Figure 1-33). This site is on the east side of the Banana River, due west of the Cape Lighthouse. Tel-4 has been operational since early 1966. This station is capable of data acquisition, data storage, data processing, preparation of computer-formatted magnetic tapes, tape copying tape playback, providing analog charts/recordings and interfacing video retransmission. Separate display areas are equipped with direct write thermal pen recorders, oscillograph recorders, and digital displays for the convenience of range users. Computer-ready magnetic tapes may be formatted in real time or from pre-recorded data tapes. Facilities exist to produce duplicate pre-detection or video magnetic tapes. Signal distribution and interconnection of the data-handling system is accomplished mostly by a remote patch control system known as the video remote patch (VRP) rather than through manual patch panels. Tel-4 also functions as the uprange central receiving and data distribution center and retransmits data via communication links to range user's outside facilities.

1.2.2.3.2 JDMTA

The Jonathan Dickinson Missile Tracking Annex (JDMTA) at Tequesta, Florida, approximately 100 miles south of Cape Canaveral, is designated Station 28. JDMTA has been operational since 1987. JDMTA is a unique station equipped with 2.2-2.4 GHz antenna systems capable of tracking four separate targets (see Figure 1-33). This station has facilities that record, display, and retransmit data directly to Tel-4 for distribution to the Range Operations Control Center (ROCC) for Range Safety display or to outside user facilities.

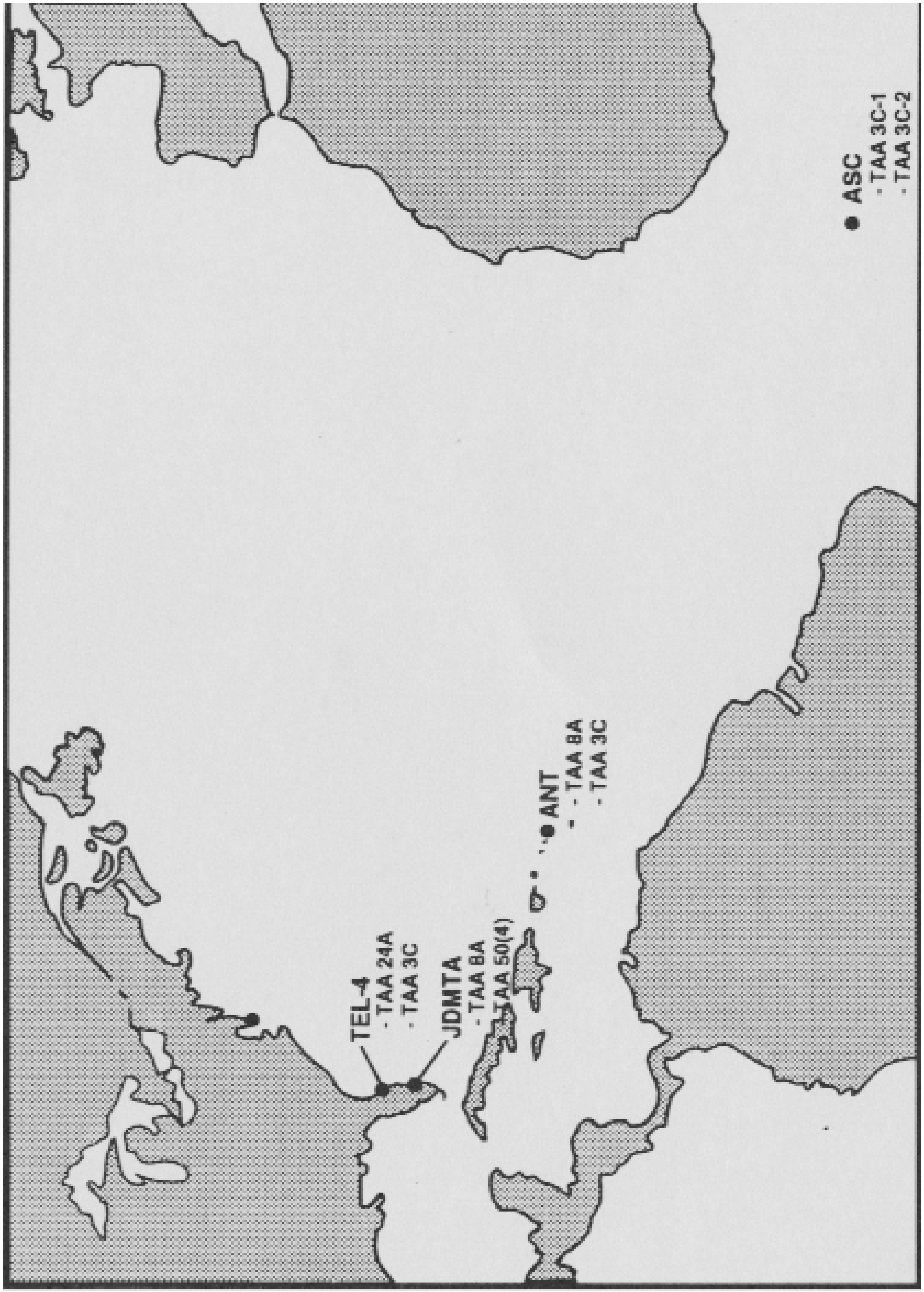
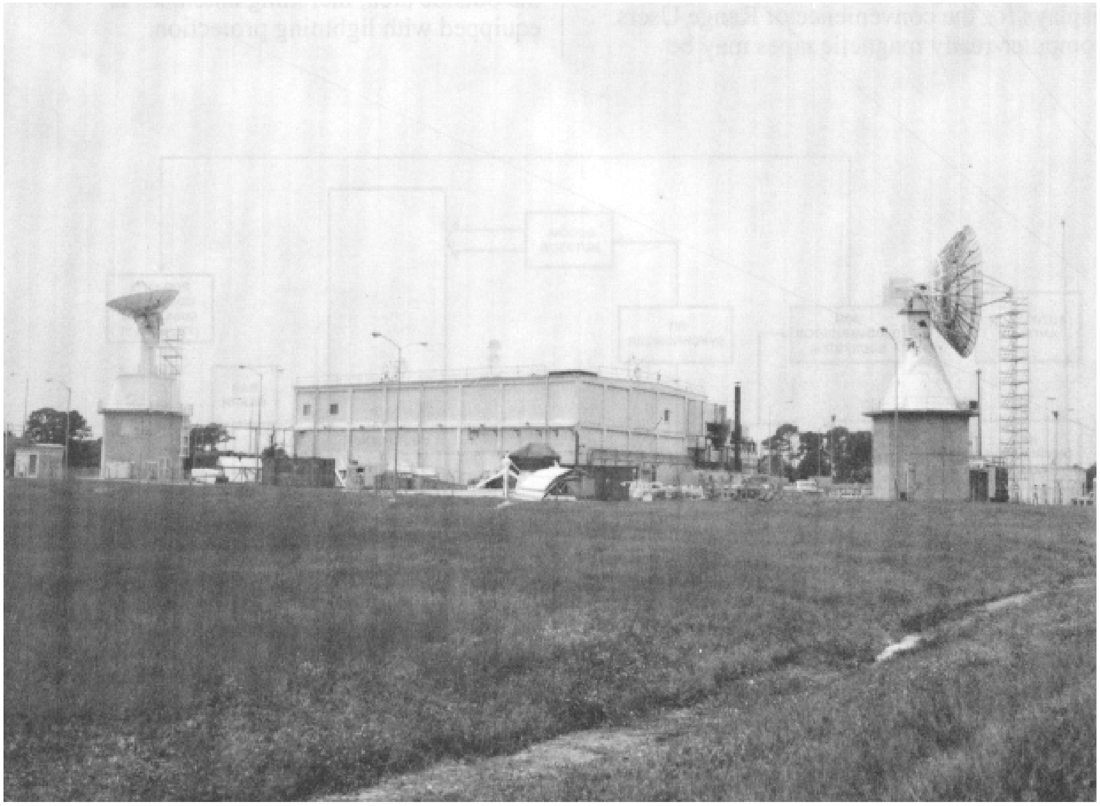


Figure 1 - 32: Locations of Typical ER Telemetry Mission Support



TEL IV

JDMTA Telemetry

Figure 1 - 33: Uprange Telemetry

1.2.2.3.3 Antigua

Downrange Station 91, Antigua, operates on the Island of Antigua, British West Indies. The telemetry facility is off the main Air Force base, adjacent to the southeast corner of the airstrip closed runway at Barnacle point. The TAA-3A and the TAA-8A antennas are shown in Figure 1-34. The site is about 1,250nm downrange and supports mid-range launch trajectories. A new, modern facility has been constructed on a hill just north of the telemetry site, designated the Central Instrumentation Facility (CIF). New telemetry systems are being developed and installed and are planned to be operational by 1999 under the Range Standardization and Automation (RSA) contract.

1.2.2.3.4 Ascension

The most distant downrange station is Ascension, Station 12, about 5,000nm downrange of Ascension Island in the South Atlantic Ocean. The telemetry complex is on South Gannet Hill overlooking the east end of the airstrip runway (see Figure 1-35). At about 730 feet above sea level, the four antennas on the site have a field of view advantage into the distant off-shore SMILS array. Real-time or near real-time data is provided via DSCS satellite to CCAS and to Tel-4. This station provides terminal reentry track and spacecraft tracking during transfer orbits, as well as orbital tracks. (see Table 1-5)

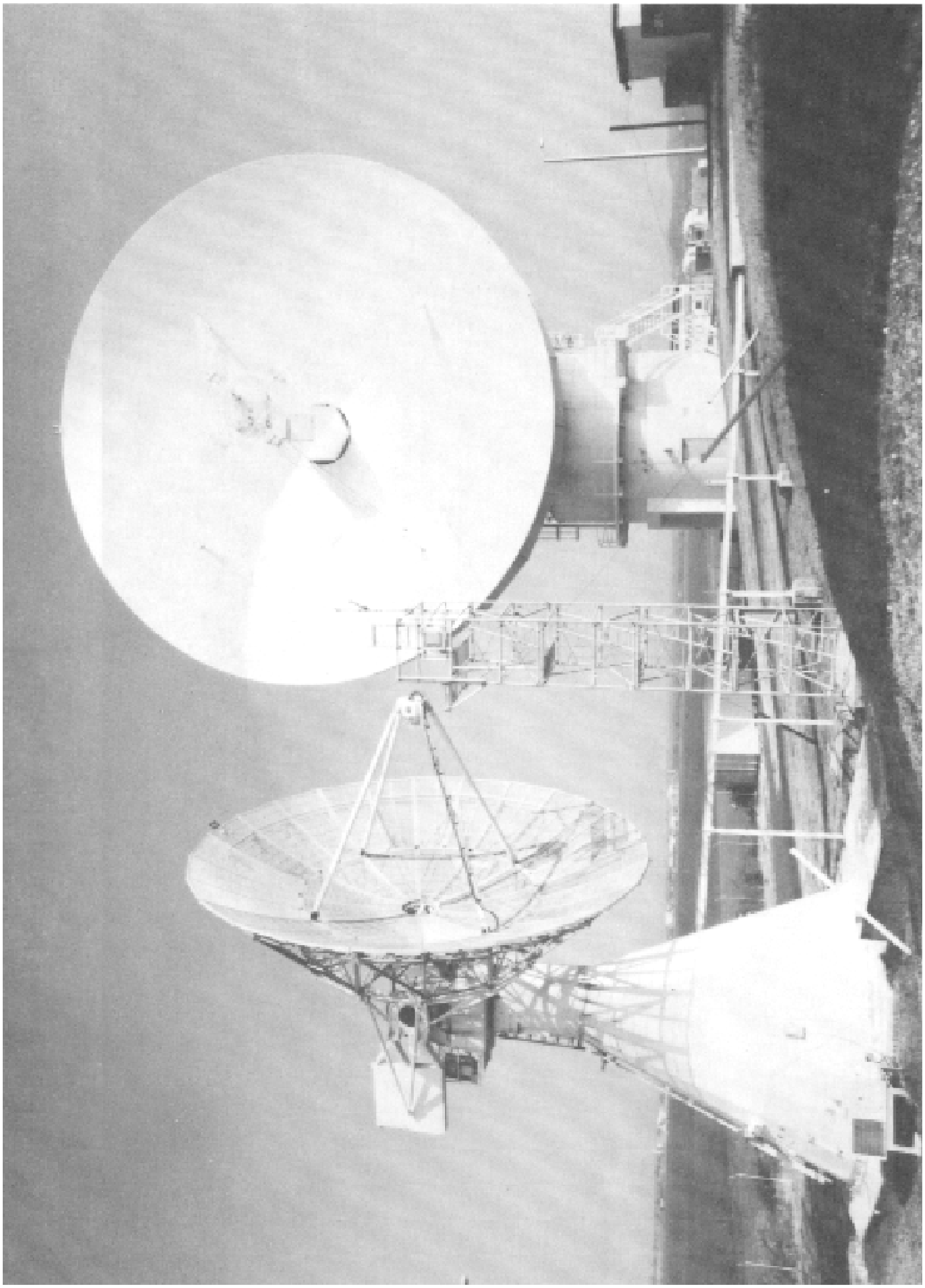


Figure 1 - 34: Downrange Telemetry - Antigua

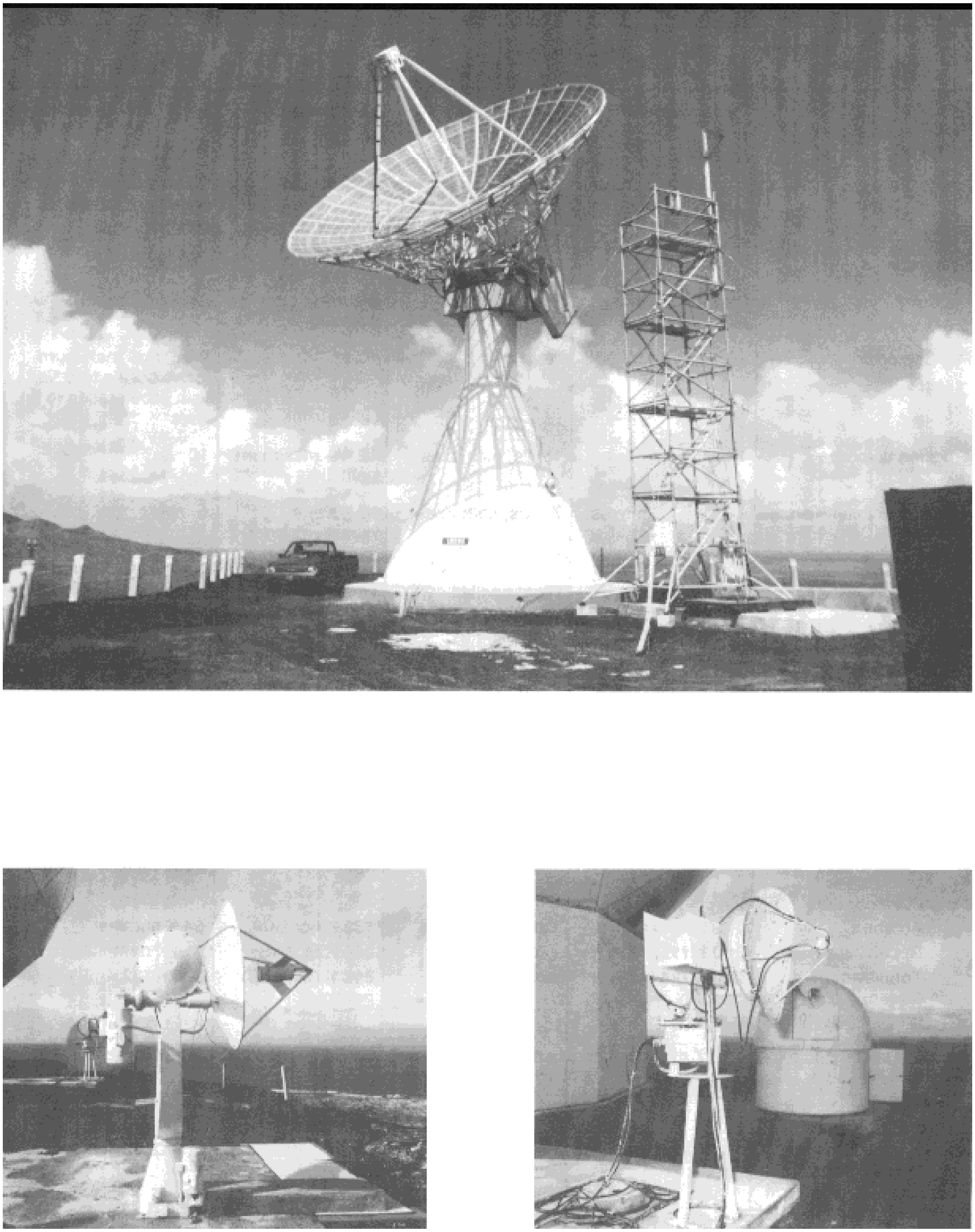


Figure 1 - 35: Downrange Telemetry - Ascension

Table 1 - 5: Fixed Telemetry Systems

Location	Antenna Type	Diameter	Frequency Range	Polarization	Trackin Velocity	Gain	Beamwidth	Scan Range
TEL-4	TAA-24A	24 ft	2200-2400 MHz	LHC RHC	12^{o}/sec, both axes	41.6 dB	1.35^{o}	30 Hz
	TAA-3C	33 ft	2200-2400 MHz	LHC RHC	15^{o}/sec, both axes	42.9 dB	0.9^{o}	10 Hz
	C-Band	6 ft	3700-4200 MHz	Linear; Vertical and horizontal	12^{o}/sec both axes	33.5 dB	2.5^{o}	
JDMTA	TAA-50's (l,2,3,5)	50 ft	2200-2400 MHz	LHC RHC	10^{o}/sec	48.9 dB	0.57^{o} at 2200-2300 MHz 0.55^{o} at 2300-2400 MHz	100 Hz
Antigua	TAA-3C	33 ft	2200-2400 MHz	LHC RHC	15^{o}/sec both axes	42.2 dB	0.9^{o}	900 Hz
	TAA-8A	80 ft	2200-2400 MHz	LHC RHC	10^{o}/sec both axes	51 dB	0.34^{o}	97 Hz
Ascension	TAA-C-2	33 ft	2200-2300 MHz	LHC RHC	15^{o}/sec both axes	43 dB	0.9^{o}	94 Hz
	TAA-3C-1	33 ft	2200-2400 MHz	LHC RHC	15^{o}/sec both axes	42.2 dB	0.9^{o}	900 Hz
	Fixed S-Band	2.3 x 3 ft elliptical	2200-2300 MHz	RHC		21.5 dB	15^{o} vertical 10^{o} Azimuth	
		4 ft	2200-2300 MHz	LHC RHC		20.5 dB	11^{o}	

TAA: Telemetry Autotrack Antenna

1.2.2.4 Communications

The ER uses an extensive communications network consisting of communication satellites, microwave links, high frequency (HF) radio, and various landline links to connect the sites and stations of the range with each other and the world (see Figure 1-36). This network provides the flexibility and reliability necessary to conduct the various operations supported by the range. In addition, the range receives mission support communications services from, or provides to, other test agencies such as NASA, U.S. Navy, and the 4950th Test Wing (ARIA). The range also provides non-mission communication services on both a temporary and a continuing basis to the US Army, US Navy, other Air Force agencies, NASA, US State Department, other US Government agencies, and certain commercial carriers.

Operational control of the ER communications is exercised by the communication control centers at each major station. These centers allocate, monitor, and maintain transmission quality of all on-base and off-base circuits and technical operations nets for each respective station. Equipment and capabilities are limited to manual and semiautomatic operation. In most cases, semiautomatic control of a system or piece of equipment is accomplished by providing remote control of that piece of equipment to some other location. The equipment that is remote is usually controlled from a communications control building. For example, an antenna field may be remote to the transmitter station located at the central communications control building for some site.

CCAS is the communications focal point for all range circuits and range user nets, and domestic commercial carriers interconnect to all other Government agencies (see Figure 1-37). All other communications control centers report to the CCAS communications control hub. Antigua is the nodal point for the Caribbean area, while Ascension Island is the net control station for ship and aircraft operations in the Atlantic, Africa, and the Indian Ocean areas. Antigua and Ascension have complete manual and semiautomatic range communication control center capabilities. Jonathan Dickinson Missile Tracking Annex also has its own communications control center which collects data and sends it to CCAS and receives data from CCAS.

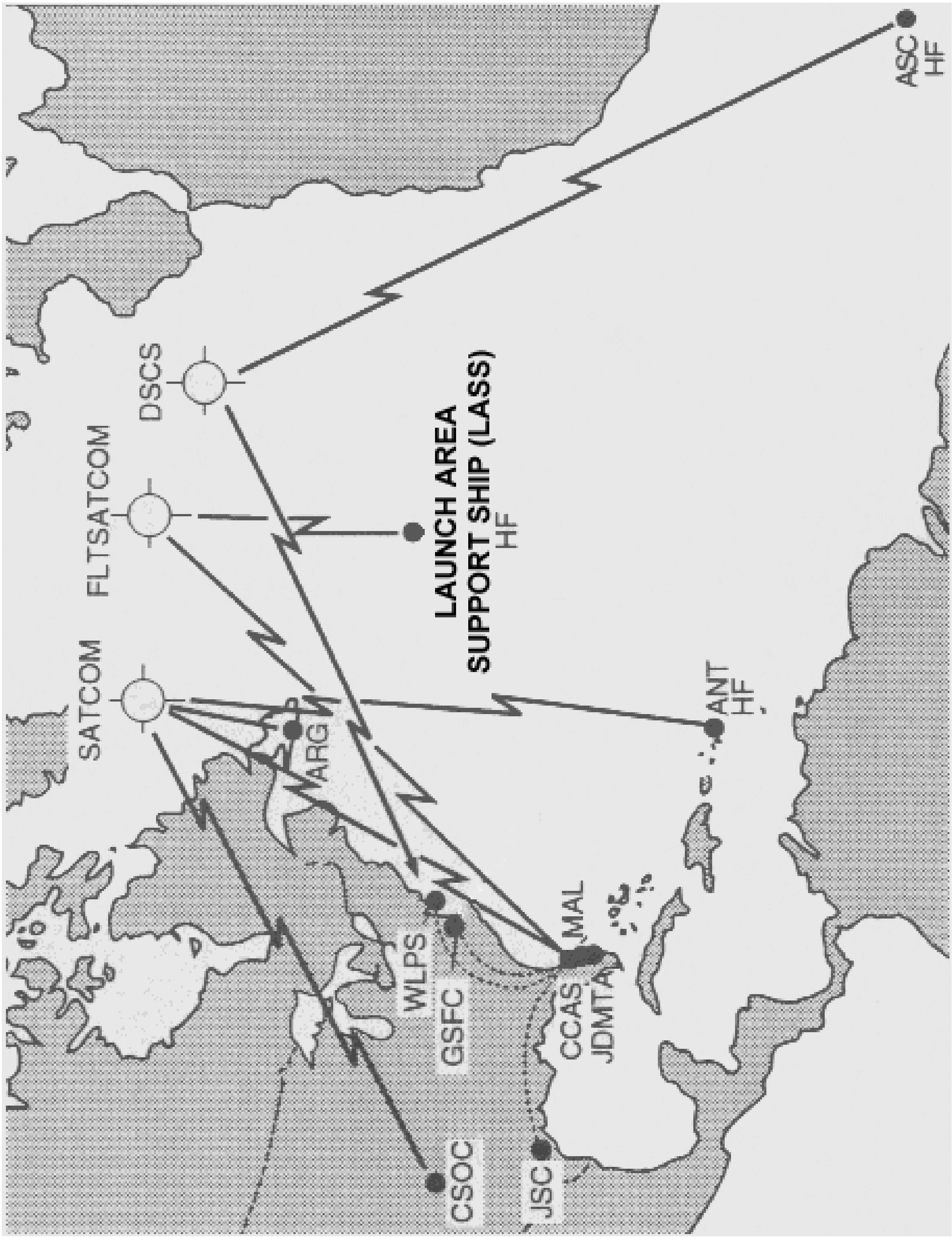


Figure 1 - 36: ER Communications Links

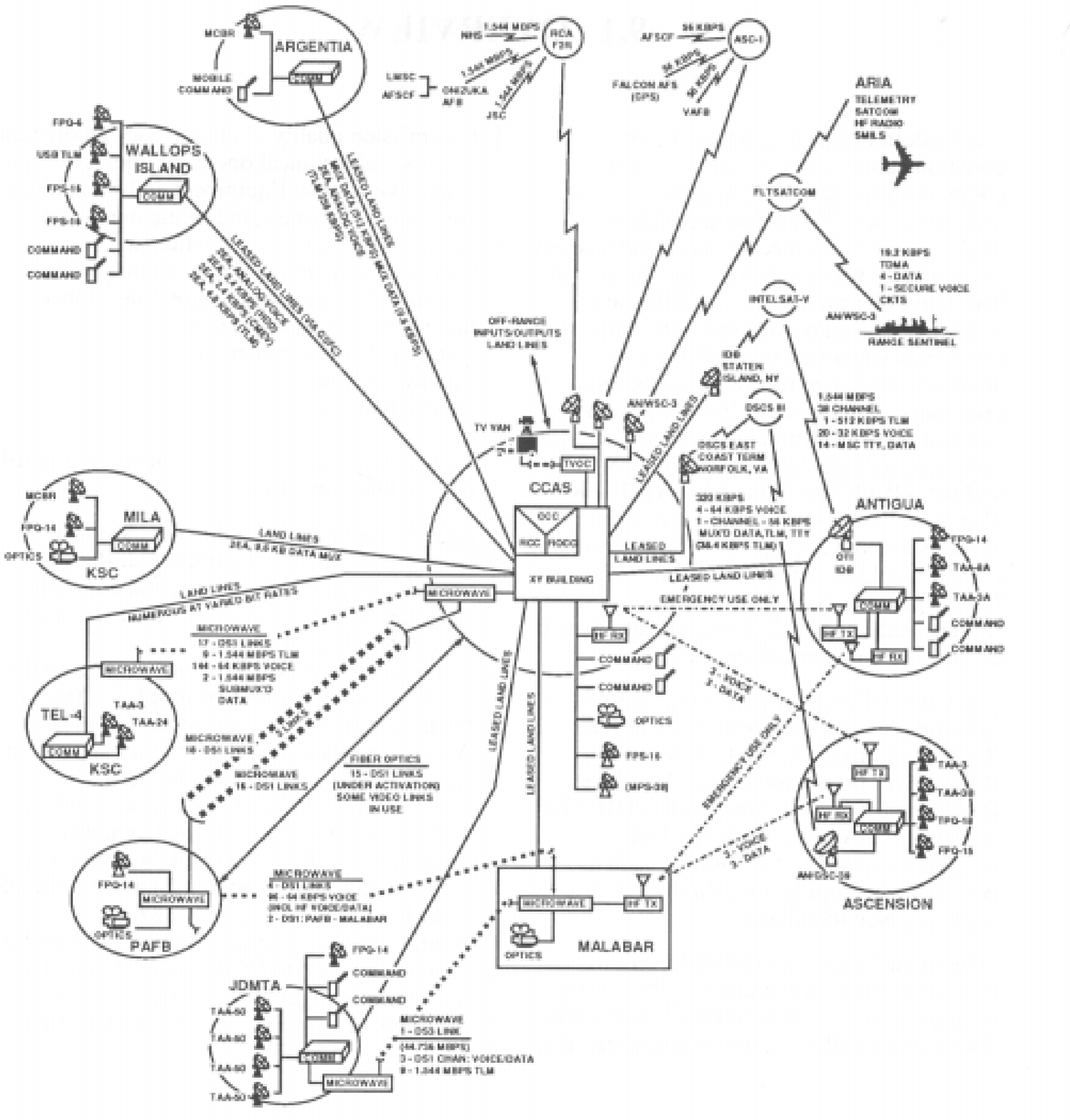


Figure 1 - 37: ER Communications Network

1.2.2.5 Command Destruct

The purpose of the Command Destruct System (CDS) is to transmit encoded commands to missiles and spacecraft in flight. The CDS is used to provide Range Safety protection on all launches on the ER to prevent errant missiles from endangering persons or property on and adjacent to the range. The CDS consists of a network of UHF radio transmitters located at CCAS, JDMTA, Antigua, and Argentia, Newfoundland (see Figures 1-9 and 1-38). Figure 1-39 shows the commands sites at CCAS, JDMTA, and Antigua. Figure 1-9 shows the Argentia Newfoundland site with the command domes being behind the fenced power substation at the right of the picture. These sites are linked to the Central Command Remoting System (CCRS) located in the CCAS Range Operations Control Center (ROCC). Mission Flight Control Officers (MFCO) evaluate the real-time data via the Range Safety Display System (RSDS) to determine if the vehicle is within the flight safety limits or if it is necessary to transmit arm and/or destruct commands to terminate the flight of errant vehicles. Examples of Range user applications of the CDS include the transmission of commands such as safing the FTS and engine cut-off, as well as vehicle control messages such as payload deployment.

For northerly launch azimuths, the NASA Wallops Island stations are used by Range Safety when coverage from these stations is needed. In addition, the Argentia, Newfoundland site can be used for support as required.

FCO-generated commands are sent through the CCRS to a remote transmitting station (CCAS, JDMTA, Antigua, Wallops Island, or Argentia) and then to the in-flight vehicle. The modulated commands monitored at the transmitting antenna are decoded, checked for accuracy, and relayed back to the FCO to confirm the transmission. Command transmissions are recorded for post-flight evaluation. 127-1 requires that the Automatic Gain Control (AGC) from the vehicle command receiver is reported to the FCO via telemetry for assurance that the command receivers on the vehicle are operating (see Table 1-6).

A Central Command Remoting System (CCRS) is used to monitor the status of the command transmitters and select the optimum transmitter, based on vehicle present position and site bias, that will radiate an adequate carrier signal to the launch vehicle. Remote control of the command system transmitters is required which has the capability of enabling and disabling remote station command capability. CCRS manual control capability is required to backup the automatic system. Indictors located immediately above the Flight Termination Unit (FTU) switches illuminate when the CCRS detects a transmitted command. Command transmission is also displayed on monitor screens. CCRS status indications on the monitor screens include:

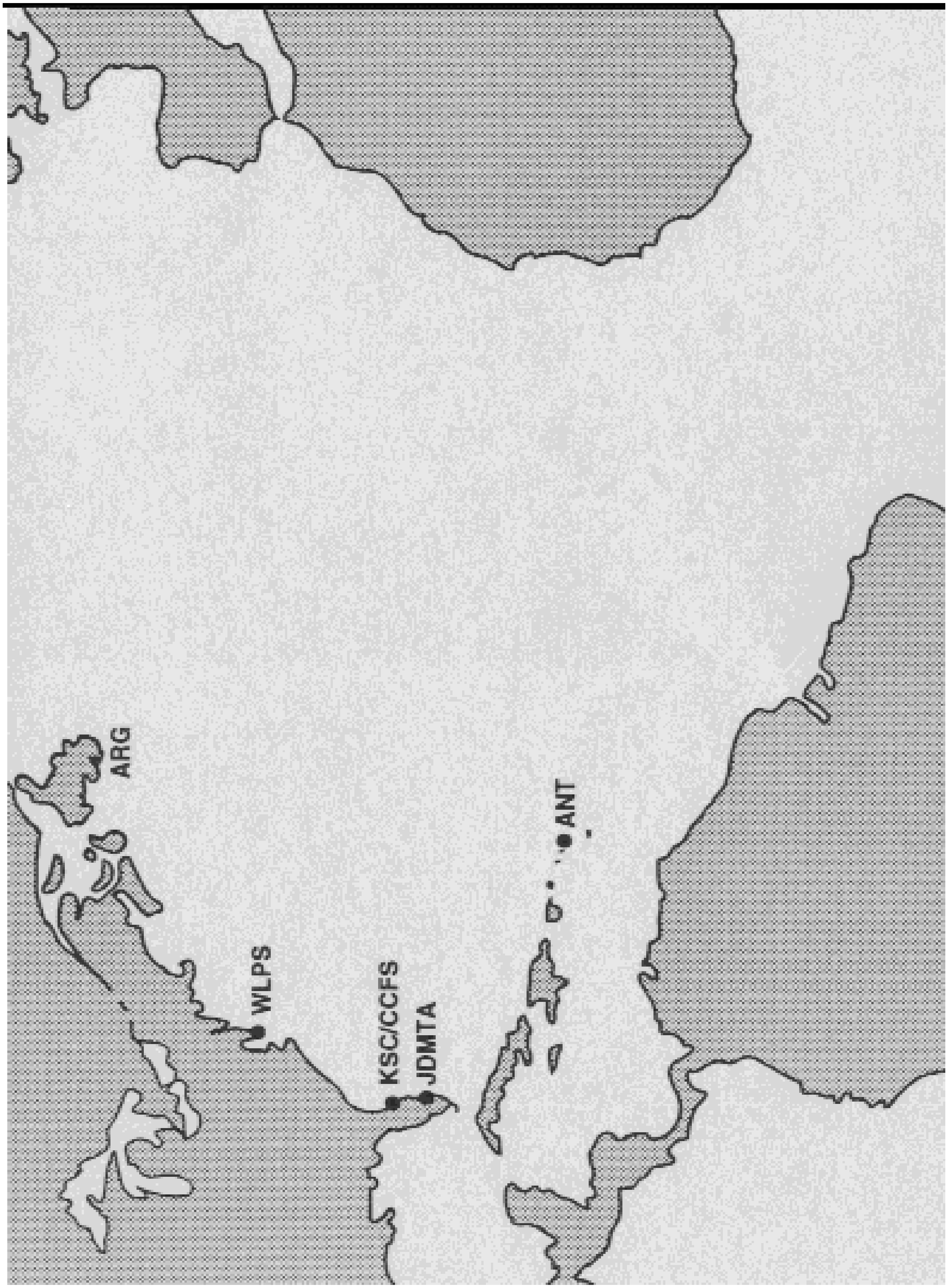
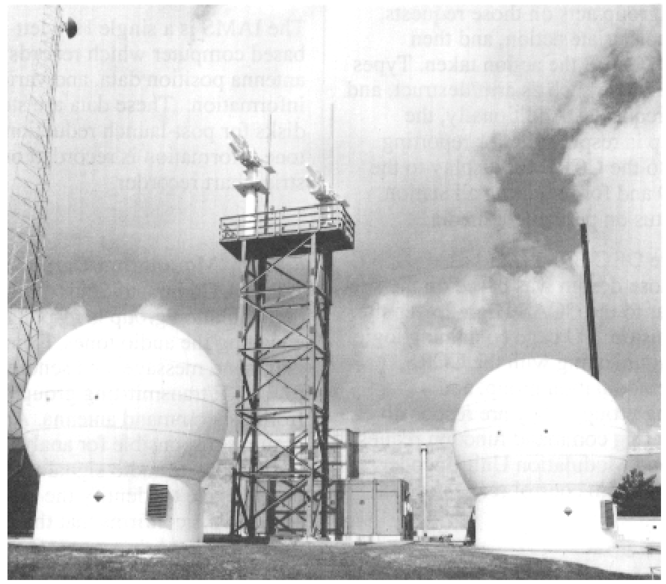


Figure 1 - 38: ER Supporting Command Site Locations

CCAS Command



JDMTA Command

Antigua Command

Figure 1 - 39: ER Command Systems

Table 1 - 6: Command Station Transmitter and Antenna Capabilities

Station	Antenna	Antenna Beamwidth	Transmitter Type	Maximum Transmitter Power	Operating Power	Gain (db)	Effective Radiated Power (d3m)
CCAS	Canoga No. 1 Steerable	18^o	RS-10	10KW	8KW	18	84.83
	Canoga No. 2 Steerable	18^o	RS-10	10KW	8KW	18	84.63
	Melpar Omni-directional	N/A	RS-10	10KW	8KW	0	67.55
	Canoga (1 or 2) Steerable	18^o	RS-1	600W	600W	18	74.16
JDMTA	Datron No. 2 Steerable	10^o	RS-10	10KW	8KW	21	88.79
	Datron No. 2 Steerable	10^o	RS-10	10KW	8KW	21	88.49
	Flam & Russell Broadbeam	27^o x 45^o	RS-10	10KW	8KW	15	Function of Azimuth and Elevation
Antigua	ESCO Tri-helix	18^o x 30^o	RS-4	10KW 4KW	7KW 4KW	15	82.23 79.80
	TEMEC dish	8.5^o	RS-4	10KW	7KW 4KW	23	88.99 86.56
Argentia	EMP	18^o	RS-2	2KW 1KW	2KW 1KW	21	83.39 80.38
	Antlab	18^o	RS-2	2KW 1KW	2KW 1KW	21	83.39 80.38
Wallops Island (NASA)	Antlab Steerable No. 1 and No. 2	20^o	ALEPH CTS-100	1KW	600W		

- command site readiness,
- the site transmitting the command carrier,
- the site tracking elevation angles,
- transmitter fail-over,
- system automatic/manual mode,
- Missile Flight Control Officer (MFCO) command destruct capability as active or locked out and
- the command issued and the time of transmission.

An FTU is located at each MFCO console position. The FTU switches are programmable for Arm, Destruct, Safe, and other, optional commands that may be required for a mission. Switches having no functions programmed for a launch are disabled. Each switch on the FTU has a status indicator located immediately above it. When an active switch is thrown, the indicator displays the command requested and verification of transmission.

The CCRS equipment consists of the Command Message Encoder Verifiers (CMEV's), the Command System Controller (CSC) console, the Range Safety Control and Display (RASCAD), the Flight Termination Units (FTU's), communications modems, and the Message Storage Unit (MSU). All equipment is dual-redundant with automatic reconfiguration.

The CMEV's are the control center of the entire Command Destruct System (CDS). Each CMEV is connected to four control consoles: two operational consoles in the Range Safety Operations area (RASCAD) and two checkout consoles in the CCRS (CSC). From these consoles, the Mission Flight Control Officer (MFCO) or the Command Controller may request the command carrier and/or Range Safety functions at any command station. These consoles may be configured to operate redundantly on a single mission or independently to support up to four missions simultaneously. During real-time launches, the CSC consoles may be inhibited by means of a key-locked switch.

The CMEV's are configured to run in a prime/backup mode. The prime, or online, CMEV handles all communications to the remote sites and the console indicators. Both the prime and backup systems receive the same inputs from the command sites and the console switches. If the prime system fails, the backup becomes prime and takes over with no loss of continuity. The switchover may be requested manually by the CSC or performed automatically by the software or hardware if an error is detected.

The CMEV's verify when a carrier or command function is requested on or off by any of the consoles by monitoring the request on two separate hardware lines. If there is a disagreement, a CMEV switchover results. If the new online CMEV also sees a disagreement, the command is invalid; if it is not, the CMEV performs additional checks, depending on the mission mode. All checks must be passed successfully before any request messages are transmitted to the command sites.

1.2.2.6 ER Command Remoting System

The ER Command Remoting System (CRS) consists of dual command message encoder/verifier (CMEV) units located in the operations control center referred to as the Central CMEV's, the command remoting links, dual site CMEV's located at each of the UHF command transmitter sites, and the Range Safety Control and Display (RASCAD) (see Figure 1-40).

a. The CRS monitors the status of the command transmitters located at committed sites. Based on vehicle present position and site bias, the CRS automatically selects the optimum command transmitter site to radiate an adequate carrier signal to the launch vehicle.

b. The CRS is required for the remote control of the command systems transmitters and are capable of enabling and disabling remote station command capability.

c. CRS manual control capability is required to back up the automatic system.

d. Indicators located immediately above the Flight Termination Unit switches on the MFCO console illuminate when the CRS detects a command transmission such as ARM or FIRE.

e. Command transmission is also displayed on the RASCAD monitor screens. CRS status indications on the RASCAD screens include the following information:

- Command site readiness
- The site transmitting the command carrier
- Site tracking elevation angles
- Transmitter fail over
- System automatic and manual modes
- MFCO command destruct capability as ACTIVE or LOCKED OUT

- Command issued
- Time of transmission
- Command remoting link health
- Central CMEV on-line indication

An ER Flight Termination Unit (FTU) is located at each MFCO console position. The FTU switches are programmable for ARM, DESTRUCT, SAFE, and other, optional commands that may be required for a mission. The switches are programmed as specified in the applicable RSOR. Switches having no functions programmed for a launch are disabled. Each switch on the FTU has a status indicator located immediately above it and, when an active switch is thrown, the indicator displays the command requested and verification of transmission.

Proper operation of the CCS is verified to and confirmed by the MFCO prior to launch.

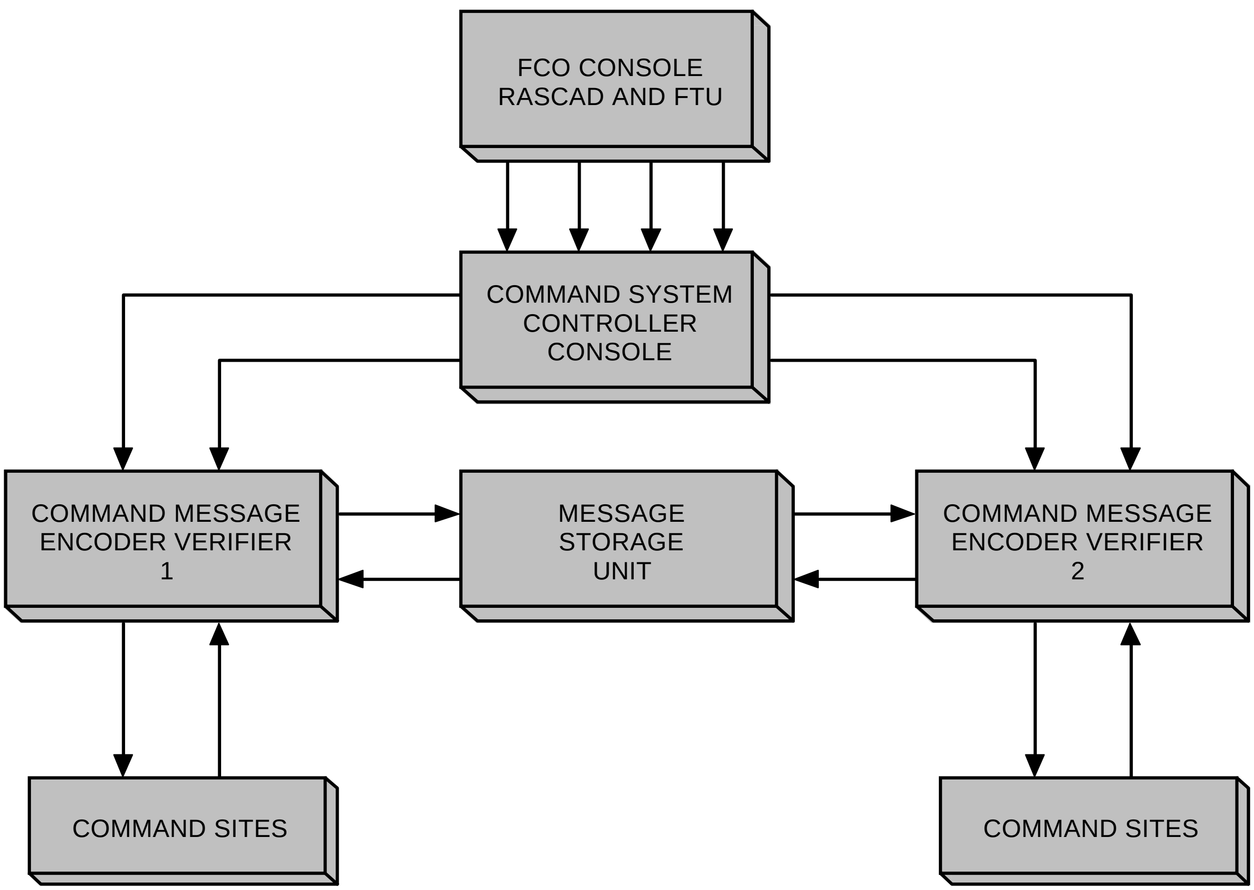


Figure 1 - 40: Central Command Remoting System

1.3 EASTERN RANGE COMMERCIAL VEHICLE SUPPORT CAPABILITY

Vehicles launched from the Eastern Range are restricted to certain launch azimuths because of the populated land areas. Specifically, it is required by EWR 127-1 that public risk criteria may not exceed a casualty expectancy of $E_c = 30x10^{-6}$ to orbital insertion. In cases of national need, a waiver may be obtained from the Wing Commander after implementing available, cost effective mitigation. In addition, the flight trajectory must be designed to accommodate Range Safety's capability to control launch related risks. A sufficient safety margin is provided between the intended flight path and protected areas so that a normal vehicle does not violate destruct limits. Also, the launch profile must not be so steep, during the initial launch phase, such that critical coastal areas cannot be protected by standard safety destruct limits.

How close to the continental US or any populated land mass a vehicle may fly is affected by its flight profile and explosive characteristics due to destruct action, impact, or catastrophic events. This can vary significantly by types of vehicles and among flights of the same vehicle, depending on payload and other vehicle configuration differences. The distance between destruct lines and the area they are to protect is entirely vehicle and mission specific. There is no required minimum distance from land for impact limit lines (ILLs). However, jettisoned stages, payload fairings and other normally discarded hardware and their associated 3 sigma IIPs must not fall closer than 100nm off foreign soil. They are positioned to protect any given land-mass (see Figure 1-5). The over-flight of any inhabited land mass is discouraged, and is approved only if operational requirements make over-flight necessary and risk analyses indicate the casualty expectancy is acceptable.

The identification of operation-related hazards and the assessment and quantification of risk is used to determine the operation constraints. The hazards associated with each source of risk (debris impact, toxic chemical dispersion, and acoustic overpressure) have critical parameters and thresholds of acceptability. Changes in launch parameters (azimuth, payload, launch site, etc.) and the need for flight safety controls (evacuation of personnel, enforcement of roadblocks, restriction of sea lanes or airspace, etc.) will depend on the results of the hazard assessments.

Representative allowable launch azimuths and a range grid are shown in Figure 1-5. Trajectory limits are dependent upon the associated risks to the "public domain" and the mission objectives. Launches with azimuths between 44 degrees and 110 degrees, with impact ranges less than approximately 3,500-miles are normally considered to be within the allowable limits. United States Government launches proposed outside of these limits have been approved, based on high priority/national security justifications and detailed risk assessments. At the present time, there are no launch constraints based solely on the physical size of launch vehicles that can be supported at the Eastern Range. The Meteorological and Range Safety Support (MARSS) can predict affected areas and concentrations of toxic commodities for both hot and cold spills.